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REPORT ON THE FISHES TAKEN BY THE BENGAL FISHERIES STEAMER "GOLDEN CROWN."

PART I.—BATOIDEI.

By N. ANNANDALE, *D.Sc.*, *Superintendent*, *Indian Museum.*

INTRODUCTION.

The trawler "Golden Crown" was purchased in England by the Bengal Government in the early part of the year 1908 and commenced work in the Bay of Bengal at the beginning of the monsoon season in June of that year. Since then she has made numerous trips, most of which have been confined to the northern parts of the Bay. Her work has not been scientific, and she is not equipped for research of any kind; but the Commissioner of Fisheries has permitted me to retain for the Museum specimens of the fish captured on each trip. The collection thus obtained has served to supplement the ichthyological investigations of Lieutenant-Colonel A. W. Alcock and his predecessors and successors as Surgeon Naturalist on the R.I.M.S. "Investigator"; for the trawl of the "Golden Crown," being of the type commonly used in commercial fishing, is of a much larger size, and therefore capable of holding much larger fish, than any likely to be used for scientific purposes in Indian seas. It has, moreover, been used mainly in water of a depth between 20 and 30 fathoms, whereas the "Investigator" dredges mainly, but not solely, at much greater depths. The collections obtained by the two vessels are therefore complementary to one another.

The "Golden Crown" has trawled along the greater part of the coast from Gopalpur in the Ganjam district of the Madras Presidency to Oyster Island off the coast of Burma, but mostly in Balasore Bay, off Konarak and Puri in Orissa, off the entrance to the Eastern Channel of the river Hughli, off the Mutlah Lightship at the entrance to the Mutlah river, and in the vicinity of Cox's Bazaar, Chittagong. Most of the ground covered has been muddy, but occasionally fine sand, coarse sand, and "coral grounds" have been worked. The so-called coral grounds, however, have not been coral reefs but places where the bottom has become sufficiently solid to afford a support for sedentary organisms of various kinds. Off Gopalpur in about 24 fathoms, for instance, enormous numbers of *Tenagodes* shells were brought up in the trawl, interwoven into rock-like masses with a Lithistid sponge; off Konarak a recent conglomerate of sand and decomposed shells was found to afford a lodging to numerous Gorgoniids and Antipatharians, some of the latter reaching a gigantic

size ; while off the coast of Arakan true fossiliferous rocks, apparently of Miocene age, were encountered, their surface being densely coated with solitary corals and molluscs of various kinds.

It has been decided that the Museum shall publish a report on the fish captured by the "Golden Crown," and the present paper is the first part of that report. Dr. J. Travis Jenkins, Scientific Adviser on Fisheries to the Government of Bengal, and Mr. B. L. Chaudhuri, Assistant Commissioner of Fisheries, will deal with the Teleosteans, while the systematic study of the Elasmobranchs falls to me. Probably Dr. Jenkins and I will deal jointly with the Selachians, as soon as we feel that the collection is sufficiently representative to be treated in a satisfactory manner.

Since Dr. Jenkins came out to India, in November, 1908, I have been indebted very greatly to him for selecting and preserving specimens and for information about specimens not preserved and the nature of the localities. It has not been possible for me to go out on the trawler myself, but Dr. Jenkins has done so regularly and, quite apart from his own work, has shown himself a most zealous coadjutor in the work of the Museum. Captain R. E. Lloyd, I.M.S., has also gone out on the trawler for one trip, and I am indebted to him for some interesting observations. I must express my obligations to the Commissioner of Fisheries for allowing me to retain specimens for the Museum and for obtaining a grant of Rs. 400 from the Government of Bengal towards the expense of illustrating the report ; to Mr. B. L. Chaudhuri for much help as regards the collection, and to the skipper, Captain Mann, and European crew of the "Golden Crown." To deal with large and powerful animals such as a full-grown saw-fish in such a way that they shall be suitable for scientific examination is a matter not devoid of difficulty and physical danger, and until November 1908 I was dependent on Capt. Mann and his hands as regards the specimens retained for the Museum.

The Batoidei, being mostly bottom-haunting species, are more commonly captured in a trawl than any other large fish. Consequently it has been possible to obtain a fairly complete collection with great expedition. Indeed, between June 1908 and March 1909 about sixty per cent. of the forms now known to inhabit the seas of British India have been captured by the "Golden Crown," while of the remaining forty per cent. at least half of the species live either at great depths or on the surface of the sea and would not therefore be taken in a trawl except by accident.

In preparing the report on the Batoidei of the "Golden Crown" I have made use not only of the old collection in the Indian Museum, but also of those in the Museum of Madras and Trivandrum, both of which, thanks to their respective heads, Mr. E. Thurston and Lieut.-Col. F. W. Dawson, I have had the privilege of examining lately. The specimens from the "Golden Crown" have been sent up to the Museum in ice, and I have thus had an opportunity, in many cases, of comparing them in a fresh condition with specimens long preserved dry or in alcohol. This has proved a very valuable opportunity, for it has been found almost impossible to identify certain species by means of the published descriptions on the basis of fresh material only. These

descriptions, including the measurements given, have evidently, in many cases, been based solely on badly stuffed Museum specimens, and the figures reproduced have had the same foundation.

It may be well to give a definite statement as to the measurements recorded in this paper. Considerations of time and space have rendered them less complete than I would have liked, for expedition is necessary, as well as a considerable amount of spare room, if several large rays preserved in rapidly melting ice are to be measured in a tropical climate before they can go bad, especially if a proportion of them are finally to be preserved as museum specimens. Whenever possible, moreover, photographs and water colour sketches have been taken as well as the measurements, in order that an accurate record of the colours and outlines of the different species may be preserved. The measurements themselves have been taken with a tape across or along the specimens,—not from point to point. This method has been adopted as providing a more accurate standard for comparison than that of measuring from point to point. Except when it is otherwise stated, the measurements have been taken on the fresh specimen before it has been dissected.

The illustrations, except when it is otherwise stated, are reproductions of photographs of frozen specimens.

The following list contains the names of the Batoidei as yet recorded or here mentioned as occurring in the seas of British India and Ceylon. I have not dealt further, however, with most of the deep-sea forms.

List of the Batoidei recorded from Indian Seas.

The names of the species not examined in connection with this report are printed in italics. Those of species taken by the "Golden Crown" are marked with a *; those of species not described or recognized by Day in the "Fauna" with a §; those species of which the types are in the Indian Museum with a †.

Family Pristidæ.

1. Pristis cuspidatus.*
2. ,, perottetii.*
3. ,, pectinatus.*
3a. ,, ,, var. annandalei.*§†
4. ,, zysron.*

Family Rhinobatidæ.

5. Rhamphobatis ancylostomus.*
6. Rhinobatis djeddensis.*
7. ,, halavi.
8. ,, granulatus.*
9. ,, *thouini.*
10. ,, columnæ.*
11. ,, schlegelii.*§

Family Rajidæ.

12. Raja mamillidens.§†
13. ,, johannis-davisi.§†
14. ,, reversa.§†
15. ,, sp. nov.§†
16. ,, powellii.§†
16a. ,, philipii (?) (= R. powellii). §†
17. *Platyrhina schonleinii.*

Family Trygonidæ.

18. Trygon microps.*§†
19. ,, uarnak.*
20. ,, gerrardii.*
21. ,, favus, sp. nov.*§†
22. ,, bleekeri.*

23. Trygon alcockii, sp. nov.*§†
24. ,, jenkinsii, sp. nov.*§†
25. ,, marginatus.*
26. ,, *bennettii.*
27. ,, imbricata.*
28. ,, zugei.*
29. ,, kuhlii.*
30. Hypolophus sephen.*
31. *Tæniura melanospilos.*
32. Urogymnus asperrimus.*
33. ,, lævior, sp. nov.§
34. Pteroplatea micrura.*
35. ,, zonura.*§
36. ,, tentaculata.*§

Family Torpedinidæ.

37. Torpedo marmorata.§†.
38. Narcine timlei.*
39. ,, brunnea, sp. nov.*§†
40. ,, mollis.§†
41. Benthobatis moresbyi.§†
42. Astrape dipterygia.*
43. Bengalichthys impennis, gen. et sp. nov.*§†

Family Myliobatidæ.

44. Rhinoptera javanica.
45. ,, *adspersa.*
46. Myliobatis nieuhofii.*
46a. ,, ,, var. cornifera, nov.*§†
47. ,, maculata.*
48. Aëtobatis guttata.*
49. ,, flagellum.*§

Family Ceratopteridæ.

50. Dicerobatis eregoodoo.
51. ,, thurstoni.
52. ,, *kuhlii.*
53. Ceratoptera orissa.

From this list it may be seen that of the fifty-three distinct species here recognized as occurring in Indian seas, no less than thirty-three have been taken during the past year by the "Golden Crown." Of the remaining twenty, seven probably live only in water deeper than that in which the operations of the fishery steamer have been conducted, while at least four (the members of the family Ceratopteridæ) are surface forms and would not usually be taken in a trawl. In the list there are twenty-one specific and two varietal names not to be found in Day's volume in the "Fauna," or there regarded as synonyms. Of these, nine belong to species described within the last few years by Alcock[1] or Lloyd[2] and, with two exceptions, taken in deep water by the "Investigator," while twelve are here recorded for the first time or have recently been recorded for the first time in the *Records of the Indian Museum.* A new genus, five new species and a new variety are described in this report.

Suborder *BATOIDEI.*

Family PRISTIDÆ (Saw-fishes).

The saw-fishes, which abound in the Bay of Bengal and make their way up some of the larger rivers, are very destructive to edible fish. Their livers yield an oil which should prove valuable (see Mr. Hooper's analysis, *postea*) and the flesh of the young is edible, although there does not seem to be much demand for it.

[1] Alcock, *A Descriptive Catalogue of the Indian Deep-Sea Fishes* (Calcutta, 1899), and *Illustrations of the Zoology of the R.I.M.S. "Investigator,"* Fishes, pls. viii, xxvi, xxvii.

[2] Lloyd, *Ann. Mag. Nat. Hist.* (7), vol. xviii, p. 311 (1906); *Rec. Ind. Mus.*, i, p. 5 (1907), and *Ill. Zool. "Investigator,"* Fishes, pls. xxxix—xli. Also "A Description of the Deep-Sea Fish caught by the R.I.M.S. "*Investigator*" since the year 1900," in *Mem. Ind. Mus.*, ii, 1909 (*incd.*).

Only one genus can be recognized, namely *Pristis*, with five species, four of which occur in the Bay.

Key to the Indian Species of Pristis.

I. Teeth absent from the base of the saw for a considerable distance.
   (*a*) From 25 to 35 teeth on each side of the saw. Anterior dorsal fin arising behind the root of the pelvic fins .. .. *P. cuspidatus.*

II. Teeth present on the base of the saw.
   (*a*) Not more than 22 teeth on each side of the saw. Anterior dorsal fin in advance of the pelvic fins for the greater part of its length. *P. perottetii.*
   (*b*) Twenty-five or more teeth on each side of the saw. Anterior dorsal fin above the pelvic fins .. .. .. *P. pectinatus.*
   (*c*) Twenty-six or more teeth on each side of the saw. Anterior end of anterior dorsal fin distinctly behind the anterior end of the root of the pelvic fins .. .. *P. zysron.*

Pristis cuspidatus, Latham.

This species is easily distinguished from all others by the following characters :—

(*a*) The rostral teeth commence at a considerable distance from the base of the rostrum ;
(*b*) Both edges of the rostral teeth are sharp, the hinder edge having a distinct barb in young individuals ;
(*c*) The lower lobe of the caudal fin is pointed and quite distinct.
(*d*) The teeth in the mouth are smaller and relatively broader than in the other species.

The broad groove which runs outwards and upwards from the outer edge of the nostril is also noteworthy, as well as the small size of the cutaneous fold on the anterior edge of the nostril.

Young specimens of this species have been caught by the "Golden Crown" on almost every voyage, but large ones are somewhat rare.

The following measurements are those of the largest specimen (♀) as yet taken, and of a large male. The former was captured at the beginning of August off Orissa, the latter in January off the mouth of the Ganges. The head, saw and fins of the female and the saw of the male are preserved in the Indian Museum.

	♀	♂
Extreme length (including saw)	309·7 cm.	245·0 cm.
Length of saw	76·4 ,,	75·0 ,,
Breadth of saw at base	7·0 ,,	8·5 ,,
,, ,, ,, at tip	3·8 ,,	4·0 ,,
Distance of first rostral tooth from base of saw ..	17·7 ,,	16·5 ,,
Breadth across pectoral fin	,,	82·5 ,,
Width of mouth	13·0 ,,	11·25 ,,

	♀	♂
Breadth of pectoral fin	39·9 cm.	..
,, ,, pelvic fin	35·0 ,,	..
Length of pectoral fin	32·5 ,,	..
,, ,, pelvic fin	23·0 ,,	..
Breadth of first dorsal fin	35·5 ,,	..
,, ,, second dorsal fin	34·0 ,,	..
Height of first dorsal fin	35·0 ,,	27·5 cm.
,, ,, second dorsal fin	25·0 ,,	26·25 ,,
Length of dorsal lobe of caudal fin	40·5 ,,	35·0 ,,
Greatest breadth of dorsal lobe of caudal fin	27·0 ,,	..

The rostral teeth are narrow in these specimens, measuring 10 mm. in breadth at the base and 21 mm. in length where they are not worn. They are very slightly retroverted and show no signs of a barb on the posterior edge, as the rostral teeth of all young examples of the species (=*P. semisagittatus*, Shaw) do (see Müller and Henle, *Syst. Beschr. d. Plagiostomen*, pl. 60, 1841). The male has 27 teeth on either side of the saw; the female 27 on the right and 28 on the left.

The colour of young individuals is a dark leaden grey on the dorsal surface, fading to pale grey on the belly. The back of old specimens is considerably paler than that of the young and is tinged with green in life.

Pristis cuspidatus is confined to the seas of India and the Malay Archipelago. It is common at the mouths of the Ganges.

There is an interesting abnormal (stuffed) specimen of this species in the Museum. The anterior dorsal is entirely absent, but a slight scar on the skin of the back would suggest that it had been removed accidentally. In front of this scar there is a longitudinal band of small, broadly heart-shaped, flattened denticles, which is broadest posteriorly and becomes gradually narrower in front, reaching slightly beyond the anterior margin of the pelvic fins. The specimen is a young one, measuring about 80 cm. in length and was purchased in the Akyab market in 1906.

Pristis perottetii, Müller and Henle.

This species is distinguished from *P. pectinatus* and *P. zysron* by the small number of its rostral teeth (not more than 22 pairs) and by the position of its first or anterior dorsal fin, which originates considerably further forward on the body than the pelvic fins.

This species is very common in the estuaries of the Ganges and Brahmaputra, which it ascends for at least a hundred miles, often being captured in fresh water. The following are the measurements of two large females taken by the "Golden Crown," A in November off Arakan and B in October off Orissa.

	A.	B.
Extreme length (including saw)	656·0 cm.	561·0 cm.
Length of saw	145·0 ,,	130·0 ,,
Breadth of saw (at base)	27·0 ,,	22·7 ,,

	A.	B.
Breadth of saw (at tip)	11·2 cm.	7·8 cm.
Width of mouth	45·6 ,,	..
Breadth of pectoral fin	126·6 ,,	..
,, ,, pelvic fin	63·3 ,,	..
Length of pectoral fin	101·3 ,,	..
,, ,, pelvic fin	81·0 ,,	..
Breadth across pectoral fin	304·0 ,,	228·0 ,,
Breadth of first dorsal fin	63·3 ,,	..
,, ,, second ,, ,, ...	35·3 ,,	..
Height of first dorsal fin	63·3 ,,	..
,, ,, second ,, ,, ...	63·3 ,,	..

It will be seen from these measurements that the proportionate length of the saw varies considerably. In specimen A it is slightly over $\frac{1}{5}$ of the total length, while in B it is just about $\frac{1}{4}$. The teeth in these specimens are very stout, with the posterior edge strongly grooved. They measure in A 27 mm. in breadth at the base and from 73—78 mm. in length, in B 18—20 mm. in breadth at the base and 50—68 mm. in length. The teeth at the tip bend forwards slightly in each case. A has 17 and B 18 pairs. The number on the sides of the saw, however, is not always the same. I have examined specimens with 22 teeth on one side of the saw, but none with so many on both sides. Several have 20 on one side and 21 on the other.

The adult female of this species is dull grey on the dorsal surface, almost white on the belly, and the male does not appear to differ from the female in coloration.

Pristis perottetii is found in all tropical seas and estuaries and is closely related to *P. antiquorum* of the Mediterranean and Atlantic, from which it may be distinguished by the fact that in the latter the first dorsal fin is situated immediately above the pelvic fins.

Pristis pectinatus, Latham.

This species is easily distinguished from *P. perottetii* by the larger number of its rostral teeth (25—34 pairs). From *P. zysron* it may be distinguished by the fact that the anterior edge of the first dorsal is situated almost immediately over that of the pelvic fins.

The saw is short and tapers considerably, but Day is not correct in saying that it is always twice as broad at the base as at the tip, the proportion being sometimes about 4 to 3. The rostral teeth are rather slender and are grooved posteriorly; at the base of the saw they are, in old specimens, three or four times as distant from one another as they are at the tip. I have not seen a specimen in which they had the same number on both sides of the saw. The true teeth, in the mouth, resemble those of *P. perottetii*. The head and forepart of the body are flatter in *P. pectinatus* than in any other species I have seen. The second dorsal fin is always slightly smaller than the first.

Although this is caommon species in the estuaries of the Ganges and is well represented in the collection of the Indian Museum, I have found no complete specimens

of the typical form among those sent me from the "Golden Crown." A number of severed saws, however, appear to belong to this form.

Pristis annandalei, Chaudhuri. (Pl. v, fig. 4.)

P. annandalei, *Chaudhuri*, *Rec. Ind. Mus.*, ii, p. 391, text-figure.

I do not now think that this form is more than a variety of *P. pectinatus*, if, indeed, it is not the typical adult male of that species. The main difference lies in the coloration, and this is not only a character that is lost in dried specimens, but is also one that may very well be sexual or even seasonal. In all the species of the genus variation occurs as regards the exact proportions and outlines of the fins and saw, and I do not think, after comparing dried specimens, that the structural features which separate *P. annandalei* from the specimens of *P. pectinatus* in the Museum, are beyond the limits of such variation, although I agreed with Mr. Chaudhuri at the time he described his species that it was new. When fresh it exhibited a brilliancy of coloration much superior to anything that I have seen in any other specimen of the genus. The back was of a bright ashy grey, which faded into blue on the sides and then changed to pale yellow. The anterior margins of the dorsal fins were bluish grey, but the body of all the fins was orange-yellow suffused with red. The claspers were of a bright brownish red, and there was a conspicuous orange-red line running down each side of the saw and interrupted by each tooth. The following are the measurements of this specimen, which was taken in July off the coast of Burma in shallow water.

Total length (including saw)	306·7 cm.
Length of saw	56·0 ,,
Width of saw at base	7·9 ,,
,, ,, ,, at tip	4·0 ,,
Width of mouth	15·5 ,,
Length of pectoral fin	55·5 ,,
,, ,, pelvic fin (including claspers)	61·5 ,,
Height of anterior dorsal fin	45·7 ,,
Height of posterior dorsal fin	39·7 ,,

The rostral teeth are slender, measuring only from 7 to 8 mm. in width at the base and from 21 to 26 mm. in length. There are 24 on the right and 25 on the left.

A successful cast of this specimen was made and was coloured from a water-colour sketch of the fresh specimen. Figure 4, plate v, is a reproduction of a photograph of this cast. The skeleton and part of the skin have also been preserved in the Indian Museum, the number in the Museum register of fishes being F $\frac{2393}{1}$.

Pristis zysron, Bleeker.

The rostrum in this species is longer in proportion to the body than that of *P. pectinatus*; the rostral teeth are stouter, and in old specimens they are often as much as

ten times as distant from one another at the base as they are at the tip of the saw. They frequently have the same number on the two sides of the saw. The posterior dorsal fin is usually rather larger than the anterior one. There is a narrow yellowish streak along the side of the saw in large individuals of this species, as there is in all adult specimens of *P. pectinatus*, but even in the males the colours are dull.

Day says that *P. zysron* is perhaps more common in the seas of India than *P. cuspidatus*, but this remark probably applies to the Arabian Sea rather than the Bay of Bengal. Several large specimens have, however, been taken by the "Golden Crown." The measurements of two males are as follows :—

Total length (including saw)	456·0 cm.	462·5 cm.
Length of saw	127·9 ,,	120·0 ,,
Width of saw at base	12·5 ,,	26·3 ,,
,, ,, ,, ,, tip	6·25 ,,	12·5 ,,
Breadth across pelvic fin	131·7 ,,	131·2 ,,

The second of these specimens has 28 pairs of rostral teeth, the first has 25 on one side and 26 on the other. I should not be surprised ultimately to obtain a series of specimens linking *P. pectinatus* and *P. zysron* together. Undoubtedly there has been much confusion as regards the two species, and I am by no means satisfied that they are distinct. The large size of adult specimens and the difficulty with which they are preserved, however, militate against the acquisition of such a series. All the ordinary specimens of *P. pectinatus* I have seen have been less than 10 feet long with the saw, while the two of *P. zysron* I have examined in detail have been over 15 feet. I doubt whether either form grows as large as *P. perottetii*.

Family RHINOBATIDÆ (Guitar-Fishes, Spear-Sharks).

Shark-like rays (having the gills on the ventral surface) with the anterior part of the body depressed but comparatively little expanded and the pectoral fin-rays not extending forwards to the sides of the head. The snout rounded or produced, without rostral teeth. No electric organ. Two dorsal fins, without spines.

This family is divided by Günther, as by most other ichthyologists, into three genera, *viz.*, *Rhynchobatus*, *Rhinobatus* and *Trygonorhina*. *Trygonorhina*, which is distinguished from *Rhinobatus* by having the anterior nasal valves confluent, is only known from the S. Pacific, but *Rhynchobatus* and *Rhinobatus* are both well represented in Indian seas. Two very dissimilar species, however, are held by most authors to constitute the former genus, although they differ from one another considerably not only in the shape of the snout but also in the structure of the head. These two species are *R. ancylostomus* and *R. djeddensis*. The former in my opinion is not congeneric with the latter and as Gill's generic name *Rhamphobatis* is available for it, I have placed it in that genus. As regards *R. djeddensis*, moreover, I have been confronted with a difficulty in the matter of the proper genus to which it should be assigned. It is supposed to be distinguished from the species of *Rhinobatus* by certain rather ill-defined

characters, which are discussed below. I cannot regard it as generically distinct from its allies usually placed in *Rhinobatus*.

The two Indian genera recognized in this paper are, therefore, *Rhamphobatis*, Gill (1861), and *Rhinobatis*, Bloch and Schneider (1801).

Genus Rhamphobatis, Gill.

Head rounded in front, not produced into a rostrum. Back bearing large compressed bony tubercles arranged in rows. Teeth lozenge-shaped, transverse, with many sinuous, parallel transverse ridges.

I have made a careful comparison between the skull of the one species of this genus and that of *Rhinobatis djeddensis*. The cranial cartilages are somewhat different in the two species. In the latter a single rostral cartilage projects forward between the nasal capsules; its ventral surface is hard, solid and undivided, but there is a broad and lengthy longitudinal depression on the dorsal surface. In *Rhamphobatis*, on the other hand, a pair of rostral cartilages, which are much broader and flatter than the single one in *Rhinobatis* and only joined to one another at the base by membrane, arise in the same position and only unite as cartilages near the tip of the snout. The condition in *Rhinobatis granulatus*, *R. schlegelii* and *R. halavi* is exactly the same as in *R. djeddensis*.

There is, moreover, a distinct difference between the teeth of *Rhamphobatis* and those of all the species of *Rhinobatis* I have examined. In the latter genus, although the teeth differ considerably in the different species, they may be described in all cases as having a single transverse ridge, which sometimes is raised in the centre so as to be almost conical. In *Rhamphobatis*, on the other hand, the teeth bear numerous wavy transverse ridges, none of which is much better developed than the others.

Rhamphobatis ancylostomus (Bloch and Schneider). (Pl. v, fig. 5.)

Pectoral fins with the anterior margins not joined by skin to the sides of the head. A median dorsal ridge of large, compressed, irregular tubercles running from just behind the spiracles a little more than half way to the first dorsal fin; a similar ridge on either side running along the internal margin of the orbit and spiracle and continued in a somewhat less conspicuous fashion round the anterior margin of the former; a patch of similar tubercles in front of each of these lateral ridges, which are continued posteriorly, after a considerable interruption, by short and feeble ridges in a straight line with them; a still shorter and feebler outer lateral ridge on either side parallel to the main one. The two dorsals and the caudal fin about equidistant from one another; the posterior rather smaller than the anterior; the lower lobe of the caudal long and pointed. A strong ridge on the side of the tail. Mouth strongly undulated, the two downward projections on the upper jaw and the three upward projections on the lower jaw approximately equal; the teeth lozenge-shaped, the breadth $\frac{5}{6}$—$\frac{6}{7}$ of the length; ten distinct ridges on the unworn teeth; teeth much smaller on the excavations of the jaw, than on the projections.

There is a cast of a young specimen coloured from life in the Trivandrum Museum. It is of a bright salmon-pink body colour with numerous, narrow, irregular black transverse bars. In older individuals the pink fades to a dull greenish shade, while the black bars become fainter and anastomoye into a more or less regular reticulation, at first enclosing round white spots and finally becoming almost obliterated, so that only a faint marbling persists. In old specimens, however, some dark linear markings usually remain on the base of the pectoral fins. In the male figured on plate v, fig. 5, these markings took the exact form of a ? symmetrical on the two sides.

Five specimens have been taken to my knowledge by the "Golden Crown," four of them fully adult. One (♀) was captured in October off the Orissa coast, and two (♂, ♀) in December off the mouth of R. Hughli. The measurements of the former and of one of the latter were as follows :—

	♀	♂
Total length	204·0 cm.	206·0 cm.
Breadth across pectoral fins	131·0 ,,	134·0 ,,
Mouth to vent	..	73·0 ,,
Width of mouth	..	25·3 ,,
Distance between eyes	25·3 ,,	27·8 ,,
Anterior border of pectoral fins	35·4 ,,	45·6 ,,
Anterior border of pelvic fins	22·8 ,,	13·9 ,,
Anterior border of 1st dorsal	32·9 ,,	24·0 ,,
Anterior border of 2nd dorsal	25·3 ,,	17·7 ,,
Length of upper lobe of caudal fins	44·3 ,,	30·5 ,,

Day's figure (*Fishes of India*, vol. ii, pl. cxciii, fig. 3) is evidently taken from an immature specimen. I therefore reproduce a photograph of the male whose measurements are given above.

Genus RHINOBATIS, Bloch and Schneider.

Head produced into a more or less elongated and narrow rostrum without lateral teeth.

Back bearing tubercles of various kinds in rows, or uniformly covered with granular denticles. Teeth lozenge-shaped or almost circular, with a single transverse ridge or a central conical projection. Anterior nasal valves not confluent.

Müller and Henle in separating "*Rhynchobatus*" from the species they included in "*Rhinobatus*" relied mainly (see *Syst. Beschr. d. Plagiostomen*, pp. 111 and 113) on the shape of the nasal valves, the position of the spiracles relative to the eyes and the outline of the anterior part of the body, while Günther (*Cat. Fishes*, viii, pp. 440 441) and Day (*Faun. Brit. Ind., Fishes*, i, pp. 39, 40, 42) lay great stress on the fact that the anterior margin of the pectoral fin is quite free in *Rhynchobatis* and is joined to the snout by a membrane in *Rhinobatis*. Day also notes that the anterior dorsal fin is opposite the pelvic fins in the former genus and far behind them in the latter.

The differences noted by Müller and Henle undoubtedly exist, but they seem hardly to be of generic value, considering the variation that occurs within the limits of the genus *Rhinobatis* (*sensu stricto*), nor does the difference in the position of the

dorsal fins seem to be of very great importance ; in some species (*e.g.*, *P. schlegelii*) the first dorsal is much nearer the pelvic fins than it is in others (*e.g.*, *R. granulatus*). As regards the freedom or otherwise of the anterior border of the pectoral, I fail to see any absolute difference at all in fresh or well-preserved specimens. Undoubtedly, however, there is a certain gradation in respect of this character ; in *R. djeddensis* the fin projects more freely than it does in *R. granulatus*, but in *R. granulatus* it projects more freely than in *R. halavi*. The fact that the lower lobe of the caudal is distinct in *R. djeddensis* and not so in the other species would not be regarded as a generic difference in other families of the suborder. Indeed, "*Rhynchobatus*" seems to me to be less widely separated from such a form as *Rhinobatis granulatus* than *Pristis cuspidatus* is from such a form as *P. perottetii*.

Key to the Indian Species of Rhinobatis.

I. Anterior dorsal fin above pelvic fins. Tail with a distinct lower pointed lobe .. .. *R. djeddensis.*

II. Anterior dorsal fin wholly behind the pelvic fins.

A. No fold of skin on the interval between the anterior angles of the nostrils.

A′. Interval between the posterior angles of the nostrils not markedly less than the length of one nostril.

(*a*) A row of sharp spines running down the centre of the back. Snout acutely pointed .. .. *R. granulatus.*

(*a′*) An interrupted row of obtuse spines on the back. Snout obtuse .. .. *R. halavi.*

A″. Interval between the nostrils posteriorly less than half the length of one nostril .. .. .. *R. thouini.*

B. The anterior nasal valve on each side continued as a fold of skin extending towards the other nostril.

(*b*) Back with a median row of large, smooth tubercles crossed by a vertical line of similar tubercles on the shoulder *R. columnæ.*

(*b′*) Back finely granular with faint indications of a mid-dorsal row of enlarged tubercles .. .. *R. schlegelii.*

Of the six species enumerated in this key four have been taken by the "Golden Crown," while a fifth is fairly well represented in the old collection of the Indian Museum. I have not seen *R. thouini*. *R. schlegelii* is here recorded from Indian seas for the first time ; *R. djeddensis* has been taken in very large numbers, while *R. granulatus* is represented by a single specimen in the "Golden Crown" collection and by several in that of the Indian Museum ; of *R. columnæ* several specimens have been taken by the trawler.

6. *Rhinobatis djeddensis* (Forskål).

Rhynchobatus djeddensis, *Günther, op. cit.*, p. 441 ; *Day, op. cit.*, p. 40.

Snout pointed, measured from the mouth between $\frac{1}{5}$ and $\frac{1}{4}$ of the total length ; the concavity on the dorsal surface extending forwards for a considerable distance.

Back in the adult bearing several rows of regular, compressed bony tubercles, which also surround the anterior margin of the orbits. The ventral lobe of the tail almost equal to the dorsal lobe in the young, relatively smaller in the adult. The posterior dorsal fin smaller than the anterior, which is situated over the pelvic fins. There are two conspicuous ridges on the posterior margin of the spiracle. The jaws have each a single undulation, which is not very deep. The teeth are large, suboval transversely, and bear a single transverse central ridge, which becomes obsolete as they are worn; the breadth of each tooth is to the length as 5 to 3 or 3 to 2; the teeth on the central concavity of the upper jaw are smaller than the others.

In the young the back is of a rather pale greyish olive-green, which takes a bluish tinge on the eyelids. The lateral and caudal fins and the greater part of the snout are pink. On each side, near the centre of the base of the pectoral, there is a large round black spot, which is surrounded by much smaller white spots. Numerous similar white spots are scattered on the sides of the body and a few appear on the pectorals. In older specimens the olive-green becomes darker and greyer, the spots tend to disappear, although perhaps they never become quite obsolete, and the pink changes to grey.

It is unnecessary to describe this common and well-known species at any great length. It is by far the most abundant species of its family in the catches of the "Golden Crown," whose trawl brings up numerous examples on every trip. The largest specimen I have seen measured 8 ft. 9 inches (258 cm.). It was a female with seven fully formed young ones in one oviduct, the other oviduct being empty and its corresponding ovary containing large eggs.

The unborn young measured 34 cm. in length and bore yolk-sacs, which were smaller than those of some young ones captured free. In the case of the latter the yolk-sac was as big as a small orange. There does not appear to be any arrangement for supplying the unborn young with maternal nourishment in the case of this species. Day mentions that the young are very common off the Coromandel coast about March; they are also abundant at the head of the Bay of Bengal in September and October.

Rhinobatis halavi (Forskål).

Rhinobatus halavi *and* Rh. obtusus, *Gthr.*, *op. cit.*, pp. 442, 443; Rh. halavi, *Day*, *op. cit.*, p. 43.

I have not the material on which to base a fresh description of this species, as regards the synonymy of which I merely follow Day. No specimens have been taken by the "Golden Crown" and there are only dried or immature specimens in the Museum. A stuffed female measures 128 cm. in total length, and we have a much smaller one in spirit, as well as several other skins. The short, obtuse snout is characteristic.

The teeth resemble those of *Rh. granulatus* but their transverse ridge is not so strongly convex.

Rhinobatis granulatus.

Rhinobatus granulatus, *Gthr.*, *op. cit.*, p. 443 ; *Day*, *op. cit.*, p. 42.

Snout pointed, variable in length, as a rule from $4\frac{1}{2}$ to $5\frac{1}{2}$ times in the total length ; the dorsal concavity triangular, narrow. The interval between the nostrils posteriorly not or hardly greater than the length of the nostril ; the anterior nasal valve variable in size, usually small, not produced inwards beyond the limits of the nostril. The two dorsal fins situated considerably behind the posterior margin of the pelvic fins, equal or subequal, separated by rather more than the length of anterior fin. The lower lobe of the caudal rounded, not distinctly marked off from the dorsal lobe.

The back, the central ridge of the snout and the anterior part of each dorsal fin covered in the adult with somewhat irregular, granular or obtusely pointed, small denticles, which become smaller from the mid-dorsal line outwards. There is a distinct row of sharp retroverted spines extending along the mid-dorsal line from a little behind the spiracles to the anterior dorsal fin and as a rule there are several similar spines on the anterior margin of the orbit. The lateral fins and the sides of the snout are naked. In the young (=*Rhinobatus philippi*, Müller and Henle) there are two sharp, retroverted spines on either shoulder, forming with the slightly enlarged denticles which surround them a line crossing the mid-dorsal line at right angles. On either side of the rostral ridge there is a line of similar spines; the dorsal line extends backwards between the two dorsals.

The colour of the adult is described by Day as "reddish grey superiorly, becoming dull white beneath." The young is greenish grey on the back ; the snout pure white, with the exception of the central ridge, which is of the same colour as the back.

The jaws are very feebly undulated, and it is not possible to recognize definite upward and downward projections and corresponding concavities in them. The teeth are small, transversely rhomboid, but with the four angles somewhat rounded. The transverse ridge runs across the tooth near the inner margin and is markedly convex in its centre, so that the exposed surface of the tooth as a whole has a tubercular appearance. There is no marked difference in the size of the teeth at different points on the jaw.

Only one specimen of this species appears to have been taken by the "Golden Crown," a young female from off the Orissa coast. There are, however, several other specimens in the Museum collection. The largest (stuffed) measures 185 cm. in total length.

Rhinobatis columnæ, Bonaparte.

Rh. columnæ, *Bonaparte*, *Fauna Italica*, Pesci, No. 152, plate.
? Rh. horkelii, *Müller and Henle*, *op. cit.*, p. 122, pl. 41.

Snout sharply pointed, about $6\frac{1}{2}$ times in the total length ; the distance between the outer angles of the nostrils rather more than $\frac{1}{2}$ and less than $\frac{2}{3}$ of that between the mouth and the end of the snout. The anterior nasal valve produced

into a fold which does not reach or barely reaches the lateral margin of the nostril. The back very flat; the breadth across the widest part of the pectorals $2\frac{1}{2}$ times in the total length. Pectoral fins broadly rounded; tip of pelvic fins nearly reaching base of first dorsal, which is separated from second dorsal by more than twice its own length. Rostral ridges narrowly separated. Back minutely granular with a row of smooth, rounded tubercles extending down the centre from a short distance behind the eyes to the posterior dorsal fin; a semicircle of similar tubercles extending round the inner margin of each orbit, and a short interrupted row crossing the mid-dorsal line at right angles in the scapular region.

Colour of young dark greyish brown with indistinct marblings of a darker shade and with numerous somewhat obscure, round, whitish spots; edges of snout white in smaller specimens; all the fins becoming pale at the edge; ventral surface white. The larger specimens I have examined are darker than the smaller ones and have less white on the snout, which in some is of the same colour as the back.

The mouth is straight; the teeth are small and almost flat, the ridge across them being feebly developed. They are of the same size on all parts of the jaw.

Several specimens of this species were obtained off the entrance to the Eastern Channel of the mouth of the river Hughli by the "Golden Crown" in February, 1909. The largest, a male with the claspers evidently immature and not reaching the tip of the pelvic fins, measured 42·9 cm. in length. Except as regards colour, these specimens agreed closely with Müller and Henle's figures of *R. horkelii*, which appears to be separated from *R. undulatus* mainly on account of its darker snout. A pale snout is characteristic of the young, however, not only in *R. columnæ* but also in *R. djeddensis*, *R. halavi*, *R. schlegelii* and *R. granulatus*. The same is true as regards white spots, at any rate in the case of *R. djeddensis* and *R. schlegelii*.

Both Günther and Day state that in *R. columnæ*[1] the continuation of the anterior nasal valve almost meets its pair on the other side. In Bonaparte's original figure, however, this is not represented as being the case. My specimens agree much more closely with Günther's description of *R. undulatus* than they do with his description of *R. columnæ*, but I feel bound to follow Bonaparte's figure in my identification. Some confusion probably exists between these two species, but I have not the material to clear it up.

Rhinobatis schlegelii, Müller and Henle.

Rhinobatus schlegelii, *Gthr.*, *op. cit.*, p. 445.

Snout long, pointed, but shorter than that of *R. granulatus*; the central concavity of the rostral ridge elongated and narrow. The two ridges on the posterior border of the spiracle very strongly developed. Anterior nasal valve produced into a flap which extends beyond the edge of the nostril inwards towards the middle line but does not nearly meet its fellow of the opposite side. Posterior nasal valve

[1] Since the above was written I have been able to examine a small Italian specimen of *R. columnæ* preserved in spirit. It appears to be browner than my Indian specimens and lacks all trace of white spots. Otherwise it agrees with them very closely, except that perhaps the tubercles on the back and round the orbits are a little less prominent.—*April 18th*, 1909.

strongly dilated on the margin of the nostril. Anterior dorsal fin slightly behind the pelvic fins, the claspers reaching as far as its anterior margin in the male; both dorsal fins short and high, subequal, separated by several times the length of the anterior fin. Denticles minutely granular all over the dorsal surface, barely enlarged on the mid-dorsal line.

Colour of the dorsal surface uniform brownish grey or olive-green in the adult; sides of the snout pale in young specimens; numerous faint white spots all over the dorsal surface of the body in the unborn young.

Jaws nearly straight. Teeth small, with the transverse ridge so strongly convex that when viewed in profile they appear to be almost conical with a flattened base.

Several adult specimens of this species were obtained by the "Golden Crown" off the entrance to the Eastern Channel of the river Hughli in a depth of about 30 fathoms in February, 1909, and a small male, which was presented by Mr. J. H. Row and identified by Col. Alcock, has been in the Museum for some years. It was taken in the Mutlah river, which connects the Salt Lakes near Calcutta with the sea. Günther mentions an adult female of 700 mm. and an adult male of 750 mm. from Japan. A female from the Eastern Channel with five young in its oviduct measured 500 mm., while an apparently adult male measured 336 mm. The transverse diameter across the pectoral fins was in the former case 187·5 mm. The young from the oviduct of this specimen measured 120 mm. in length and 44 mm. across the disk. Their snouts, although produced, terminated much more abruptly than was the case in the adult, the two sides being nearly parallel. In the mother the length of the snout (measured from the eyes) was contained 5·62 times in the total length, while in the young it was contained 6·66 times.

R. schlegelii has been recorded from the east coast of Africa as well as from Chinese and Japanese seas.

Family RAJIDÆ (Skates).

Head and body forming a rhombic disk, much flattened; the pectoral fins extending to the snout; tail quite distinct. Skin usually bearing spines and large denticles. Tail with a longitudinal fold on each side and a caudal fin, which is degenerate in some genera; dorsal fins present. No electric organ. No serrated caudal spine.

In Day's works on Indian ichthyology only one member of this family is recorded as occurring in Indian seas, *viz.*, *Platyrhina schonleinii*. In recent years, however, six species of *Raja* (of which four are markedly distinct from one another, although each species is founded on a single specimen) have been described by Alcock or Lloyd. A specimen which I take to belong to Alcock's *Raja powellii* was recently taken in shallow water off Trivandrum on the west coast of India and has been presented to the Indian by the Trivandrum Museum; but the members of the family belong essentially, so far as Indian seas are concerned, to the deep-sea fauna. Captain R. E. Lloyd has therefore dealt with them in a paper (to be issued in the *Memoirs of the Indian Museum* almost simultaneously with this one) on the deep-sea fishes taken by the "Investigator" since the publication of Col. Alcock's monograph. No Rajidæ have been taken by the "Golden Crown."

Family TRYGONIDÆ (Sting-Rays and Butterfly Rays).

Head and body forming a rhombic or subcircular disk; pectoral fins meeting in front of the snout; tail quite distinct. Tail without longitudinal folds, sometimes with dorsal and ventral cutaneous, rayless flaps; dorsal fins absent or very small, a recumbent serrated spine usually present on the tail. No electric organ.

Of the true rays this family is the best represented in the Indian seas, in which it is practically confined to shallow water. Four genera and twelve species are recorded by Day; to these, seven species are here added, one having recently been described and three being described below for the first time, while three were previously known but had not been found (or recognized) in Indian seas. One of the forms regarded by Day as distinct is here regarded as synonymous with another. Fifteen species have been taken by the "Golden Crown."

The Trygonidæ, although their flesh is coarse, are eaten by many castes of Indians, who attribute to them certain tonic and aphrodisiac qualities. The tails of the larger species are made into whips and walking-sticks, and there is no doubt that an extremely valuable oil could be manufactured out of their livers (see Mr. Hooper's analysis, *postea*). The fishery or estuarine species in the river Hughli, however, which is referred to by Blyth (*Journ. Asiat. Soc. Bengal*, xxix, p. 35, 1860), appears to have completely died out.

The five Indian genera may be distinguished as follows:—

Key to the Indian Genera of Trygonidæ.

I. Tail with a serrated spine, without cutaneous folds or with them rudimentary and not reaching the tip. Teeth flattened, with a transverse ridge or (rarely) with a sharp cusp; jaws not angular .. .. . *Trygon.*

II. Tail with a serrated spine, with a cutaneous fold several times as deep as itself but not extending normally to the tip. Teeth flat, without a transverse ridge; jaws angularly bent .. .. *Hypolophus.*

III. Tail without a serrated spine. Teeth without a definite transverse ridge *Urogymnus.*

IV. Tail with a serrated spine and a cutaneous fold extending to the tip *Tæniura.*

V. Disc very broad and short, angular. Tail feeble, with or without a small dorsal fin, normally with a serrated spine. Teeth saddle-shaped, with one or more sharp cusps in front .. .. *Pteroplatea.*

The first four genera in this key are very near one another and should perhaps be regarded as subgenera. In *Trygon* the serrated spine is occasionally absent, while in *Hypolophus* individuals occur in which, probably owing to injury in early life, the cutaneous fold extends to the extremity of the tail.

In diagnosing the species of this family it is particularly important that attention should be paid to fresh specimens. Many species grow to so large a size that it is practically impossible to preserve them in alcohol, while the characteristic markings disappear and the natural proportions are distorted in stuffed skins.

With reference to measurements it is necessary that an exact statement should be made as regards the methods adopted, for there are several different ways in which

each of the more important measurements might be taken. So far as the Trygonidæ are concerned I have measured the length of the disk from the tip of the mouth to the base of the tail and have not included the length of the pelvic fins. A more exact measurement might be obtained on the ventral surface, but for diagnostic purposes the one adopted is sufficiently accurate. The breadth of the disk has been measured across the back with a tape, not from point to point. This method gives a more accurate idea of the bulk of a flat fish than that of measuring from point to point, but of course it makes the deeper species, such as *Trygon microps*, appear to have a larger expanse of pectoral fin than is actually the case. The snout has been measured from a point just in front of the eyes, the interorbital space from the inner margin of one orbit to that of the other, the tail from the posterior end of the disk.

The genera of Trygonidæ are, for the most part, sufficiently defined in the above key, so far as the Indian forms are concerned. *Urolophus*, which is recorded from Java and may very probably occur within our area, is distinguished from *Trygon* by the possession of a rayed caudal fin and, in some species, a rudimentary dorsal one.

Genus Trygon, Adanson.

Disk distinct from tail (which is always powerful), more or less flattened, never very much broader than long. No rayed caudal or dorsal fins; at least one serrated caudal spine, except in abnormal specimens; a rayless caudal fold sometimes present on the dorsal or ventral surface of the tail, or on both surfaces, but never much deeper than the tail itself. Teeth as a rule flat with a transverse ridge, rarely bearing a sharp spine.

In the genus *Trygon*, an important specific character consists in the number, proportion, and outline of the cutaneous processes on the floor of the mouth behind the cutaneous fold that hangs down from the roof. These can only be investigated properly by dissecting out the mouth. Although they are not absolutely constant in any one species, the evidence they afford as to the distinction between allied species such as *T. uarnak* and *T. favus* is very valuable, for the differences they display are often strongly marked in allied species. The character of their variation is best illustrated by examples. In *T. gerrardii* (plate ii, fig. 6) there are usually four processes, the two central ones being much stouter and longer than the two lateral ones. As a rule the central ones are pointed, but in one specimen dissected (plate ii, fig. 6*a*) they are blunt and fringed at the tip. In another specimen the two lateral processes are absent. In what seems to be a normal specimen of *T. microps* there are three central processes joined together at the base so as to form a deeply serrated ridge, but in three out of the five individuals I have dissected the arrangement of these processes is not quite symmetrical, while in one there are four central processes with traces of a fifth.

Key to the Indian species of Trygon.

I. Large species (adults over 40 cm. across the disk, young over 15 cm.) as a rule with a single large serrated spine[1] on the tail; cutaneous caudal fold, if present, inconspicuous.

[1] There is usually a second, smaller one concealed under the first.

A. All the denticles with stellate bases.
  (*a*) Distance between the eyes less than half the length of the snout. Base of tail broad and flat .. .. *T. microps*.

B. All or most of the dorsal denticles with round or polygonal bases.
  (*a*) Dorsal denticles forming a regular wine-glass-shaped figure with well-defined borders.
    (a^1) Distance between the eyes less than half the length of the snout .. .. .. *T. bleekeri*.
    (a^2) Distance between the eyes more than half the length of the snout .. .. .. *T. gerrardii*.
  (*b*) Denticles not forming a regular figure on the back.
    (b^1) Dorsal denticles, if present, confined to the middle line. Dorsal surface pink or red .. .. *T. bennettii*.
    (b^2) Dorsal denticles absent from the pelvic fins, flat and rounded. Dorsal surface olive-brown with faint pale spots scattered all over the disk *T. alcockii*, sp. nov.
    (b^3) A row of sharp spines running down the middle of the back and the base of the tail. Dorsal surface olive-brown, without spots .. *T. jenkinsii*, sp. nov.
    (b^4) Flat dorsal denticles irregularly interspersed with small stellate ones on the body; the pectoral fins covered with small stellate denticles. Dorsal surface greyish .. .. .. *T. marginatus*.
    (b^5) Flat dorsal denticles irregularly interspersed with small stellate ones, which are absent from the pectorals. Dorsal surface of adult pale brown with darker markings; of young white with black spots *T. narnak*.
    (b^6) No stellate denticles. Dorsal surface of adult dark brown with a bold honeycomb pattern of dull yellow. *T. favus*, sp. nov.

II. Small species (adults less than 40 cm. across the disk, young not more than 10 cm.).
  A. Distance between the eyes about one-third the length of the snout. Dorsal surface dark brown .. .. .. *T. zugei*.
  B. Distance between the eyes less than half the length of the snout. Dorsal surface pale brown .. .. *T. imbricata*.
  C. Distance between the eyes almost as great as the length of the snout. Dorsal surface grey with bluish spots .. .. *T. kuhlii*.

The only species named in the key I have not seen is *Trygon bennettii*. Duméril (*Nat. Hist. Poissons*, i, p. 596, 1865) records a specimen of this species measuring 43 cm. across the disk, while one of Henle and Müller's was rather larger ("Plagiostomen," p. 161). All the figures I have seen, however, look as though they represent young

individuals. The adults of the other species included in Section I of my key grow over 2 feet (60 cm.) in diameter, but *T. gerrardii* does not greatly exceed this limit.

Trygon microps, Annandale. (Pl. iv, fig. 1 ; pl. ii, figs. 3, 3*a*; pl. iii, fig. 1.)

T. microps, *Annandale*, *Rec. Ind. Mus.*, ii, p. 393, pl. xxvii.

Size large (large female over 222 cm. across the disk, large male over 190 cm.).

Colour white ; the dorsal surface of the disk suffused with rose-pink, without definite markings ; tail grey above, becoming darker distally.

Disk rhombic, wider than long by more than one-quarter of the width ; the pectoral angles rather greater than right angles. Snout rounded as a whole, but with a small terminal projection which is covered with enlarged denticles. Distance from eyes to tip of snout greater than that from eye to eye ; length of snout $3\frac{1}{2}$ to $4\frac{1}{2}$ in length of disk.

Eyes very small, dark in colour, little prominent ; spiracles large, without dorsal flaps, their area more than eight times that of the eyes.

Tail without cutaneous fins, not longer than disk, consisting of a broad, flat, proximal part about half as long as the disk, and a slender, cylindrical distal part of approximately the same length, a single massive spine borne at the junction of the two parts ; a very low ridge on the ventral surface of the distal part.

Skin soft and delicate, without enlarged tubercles on the disk, bearing numerous minute, spiny denticles (pl. ii, figs. 3, 3*a*), all of which have stellate bases. The denticles larger on the tip of the snout and the region surrounding the eyes and spiracles than elsewhere, sometimes extending to the ventral surface at the edge of the pectoral fins. The proximal part of the tail armed with much larger denticles, which are largest on the sides and only bear very short stellate spines on the ventral surface ; distal part densely clothed with denticles similar to but smaller than those on the sides of the proximal part.

Mouth large ; upper jaw undulating slightly, lower jaw practically without undulation ; a coarsely digitate cutaneous flap hanging down from the roof of the mouth ; usually five short finger-like processes on the floor of the mouth, three in the centre joined together at the base and one at either side (pl. iii, fig. 1). Teeth white ; the transverse ridge very conspicuous in the unworn teeth, the part anterior to it being slightly concave and considerably greater in area than that posterior to it, which is convex.

Two specimens, both females, have been taken by the "Golden Crown," one (the type) off the coast of Chittagong in 17 fathoms in August, and a second, larger specimen off the coast of Orissa in October. In all the specimens examined, the tail looks as though it had been mutilated, but I cannot be quite sure that it is not in its normal condition. The larger specimen gave birth to a young one on board the trawler, but the young one was unfortunately thrown overboard. Owing to a clerical error, which I have been able to rectify by measuring a cast of the type specimen, the tail was represented in my original description of the species as being two feet longer than was actually the case.

FIG. 1.—*Trygon microps*, Annandale (photograph of type specimen, ♀). Scale $\frac{1}{10}$.

Since this was written three other specimens, including two males, have been taken in 24—27 fathoms off the Ganjam coast (March 1909). The claspers of the male are remarkably short. The following are the measurements of two males and two females :—

	♀ (type)	♀	♂	♂
Length of disk	137·5 cm.	170·0 cm.	130·0 cm.	135·4 cm.
Breadth across disk	195·0 ,,	222·5 ,,	187·5 ,,	191·25 ,,
Length of tail	132·5 ,,	147·8 ,,	102·5 ,,	122·5 ,,
Breadth of base of tail ..	20·0 ,,	17·5 ,,	..	..
Distance from base of tail to base of spine ..	67·5 ,,	121·5 ,,	112·5 ,,	130·75 ,,
Breadth of nasal flap ..	..	18·75 ,,	13·7 ,,	12·5 ,,
Distance between eyes ..	17·5 ,,	23·75 ,,	18·75 ,,	20·0 ,,
Length of snout from eyes ..	35·4 ,,	40·0 ,,	37·5 ,,	38·75 ,,
Length from mouth to vent ..	..	..	83·75 ,,	87·5 ,,

From these measurements it is clear that the proportions are somewhat variable in this species, the relative lengths of the tail and the disk especially being very different in the different individuals. It is very unfortunate that the young one was not preserved.

This is not only the largest species of the genus I have seen, but it differs from the other Indian forms in the shape of the tail and in the fact that all the denticles have stellate bases. The photograph reproduced on plate iv, fig. 1, is of the type, and was taken as soon as the specimen was brought ashore. It shows the peculiarities of the tail very clearly.

The type specimen (skin and skull dried, mouth in spirit) is numbered F $\frac{2410}{1}$ in the registers of the Indian Museum.

Trygon uarnak (Forskål). (Pl. i, figs. 1, 2 ; pl. ii, figs. 1, 1a ; pl. iii, fig. 2.)

T. uarnak, *Günther, op. cit.*, p. 473.

T. punctata, *id., ibid.*, p. 474 (young).

Size large (over 157 cm. across the disk in large individuals, not less than 23 cm. in young).

Colour in young white ; the dorsal surface covered with large round or oval black spots ; the pectoral and pelvic fins edged with pink in life ; the tail boldly ringed with black. As the fish grows, the white ground of the dorsal surface gradually changes first to grey and then to pale brown, the spots become dark brown in colour and coalesce in various ways to form larger spots or complicated figures. A similar change as regards colour takes place on the tail, but the dark rings remain distinct. There is often a dark margin to the ventral surface of the disk.

Disk with the lateral angles broadly rounded ; the length, considerably less than the transverse diameter. In the young the broadest part of the disk is situated at a point not much more than half the distance between the base of the tail and the

tip of the snout; while in the adult this point is situated at nearly four-fifths of the distance. All the proportions of the disk, however, are variable. The angle of the snout is rather variable but in fresh specimens it is, as a rule, slightly less than a right angle; in the unborn young it is, at any rate in some specimens, obtuse. The length of the snout, measured from the eyes, is about $\frac{1}{5}$ of the total length of the disk in the adult and between $\frac{1}{3}$ and $\frac{1}{4}$ in the young. The outline of the front of the disk is somewhat sinuous in the adult but forms almost a simple concave curve in the young.

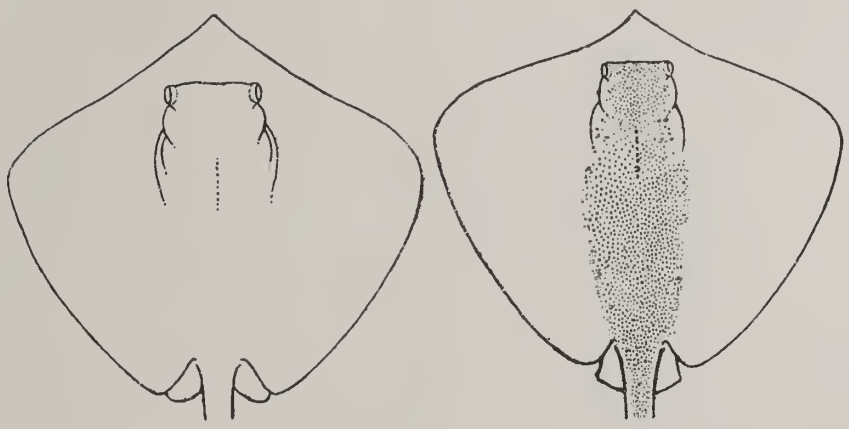


FIG. 2.—Diagram showing the difference in outline between the young (A) and the adult (B) of *Trygon uarnak*.

Eyes large and prominent, especially in the young. The dorsal wall of the spiracle forming a convex longitudinal flap.

Tail[1] more than twice as long as the disk, cylindrical, tapering, armed with a single rather slender serrated spine, which is situated much nearer the base than the tip of the tail. No cutaneous folds above or below.

Skin tough. In the young there are as a rule several relatively large rounded tubercles in the mid-line of the scapular region, and these, although at first they are sometimes practically alone, are usually surrounded by smaller, heart-shaped, nearly flat denticles which have the narrower end pointing backwards. In the adult the middle of the back is somewhat sparsely covered with similar but relatively smaller denticles, with which are interspersed numerous small, spiny ones with stellate bases. These become more numerous on the posterior part of the disk and the base of the tail, which is completely surrounded by little almost granular denticles with the spiny denticles scattered among them. This arrangement is continued for the whole length of the tail. There are no denticles on the periphery of the disk or on the ventral surface, but those on the back do

[1] In a large proportion of the larger specimens of the genus *Trygon* the tail is mutilated; it is often difficult to tell whether mutilation has occurred or not.

not disappear abruptly as the bare area is reached, but gradually become smaller and form no definite outline to the area they cover.

Mouth large. The jaws are almost straight. The teeth are large, usually more or less deeply tinged with brown in fresh specimens; in the back of the jaws, where they are not worn, each has two distinct transverse ridges, a secondary shorter one running parallel to the median ridge and in front of it. There are normally four processes on the floor of the mouth, subequal in size, the two lateral ones being only smaller than the two median, and situated at about an equal distance apart. A somewhat similar process projects into the mouth from the cutaneous fold which covers the inner base of the teeth of the lower jaw; the fold which hangs down from the roof of the mouth is somewhat coarsely digitate.

Two colour varieties of *T. uarnak* can be distinguished—

Var. *a*. Anterior part of the disk spotted in the adult, the spots combining on the posterior part into irregular blotches or figures.

Var. *b*. The whole of the dorsal surface of the disk covered in the adult with an irregular network of dark lines, often with dark spots or streaks in the centre of the meshes.

Var. *a* must be considered the typical form of the species as Forskål says in his original description "tota maculata" (*Descr. Anim.*, p. 18, No. 16*b*, 1775).

Var. *b* may be identical with *T. undulatus*, Bleeker. According to Blyth it is identical with McClelland's *T. variegatus*, but I have not seen any specimen on which the markings were so scanty and so open as they are represented in the figures published by the latter author (*cf.* Blyth, *Journ. Asiat. Soc. Bengal*, xxix, p. 43, and McClelland, *Calc. Journ. Nat. Hist.*, i, p. 66, pl. 2, fig. 2).

Day, judging from his description (*Malabar Fishes*, p. 277; *Fishes of India*, vol. ii, p. 735; and *Faun. Brit. Ind., Fishes*, vol. i, p. 53), had seen the true *T. uarnak*, but unfortunately his figure in the *Fishes of India* (pl. cxciv, fig. 1) represents not this species but *T. gerrardii*, a smaller and otherwise different species which has been confused with *T. uarnak* by several authors, notably by Müller and Henle ("Plagiostomen," p. 159, vars. 1 and 3).

I have been able to examine a very large series (some hundred specimens) of this species, representing every stage between the unborn young and the adult over five feet in diameter. Specimens have been taken practically every trip by the "Golden Crown," but Dr. Jenkins tells me that large individuals are particularly abundant in about 30 fathoms of water off the mouth of the river Hughli on a muddy bottom.

Trygon gerrardii, Gray.

T. gerrardi, *Günther, op. cit.*, p. 474.

T. uarnak, *Day, Fishes of India*, vol. ii, pl. cxciv, fig. 1.

To describe this species it is only necessary to indicate the points in which it differs from *T. uarnak*.

Size moderate (largest specimen 67·5 cm. across the disk).

Disk shaped and proportioned much as in the young of *T. uarnak*.

Colour of the dorsal surface of the young brownish slate-colour without spots, the tail being banded with black and white; the edge of the pectorals pale. As the fish grows, the colour darkens to a warm brown, and large, round, widely separated cream-coloured spots appear on the posterior part of the disk and on the pelvic fins. In still older specimens the ground colour darkens considerably, the cream-coloured spots become obsolete, and the banding on the tail disappears.

The *skin* is tough as in *T. uarnak*, but the arrangement of the denticles is quite different, at any rate in the adult. In the young they resemble those of the adult of *T. uarnak*, except that none of them have stellate bases or spiny processes. In adult and half-grown fish, however, they form a compact pavement-like surface, which occupies the middle of the disk from the head backwards and has well-defined limits, towards which they are little smaller than they are elsewhere. The outline of this surface resembles a wine-glass or flower-vase with the mouth directed forwards. On the tail this figure is continued, representing here the stem of the vase; but it ends, in front of the serrated spine, in a point. The denticles are confined to the dorsal surface of the base of the tail and do not extend either to the ventral surface of the basal part or beyond the spine on the dorsal surface.

Mouth.—The central part of both jaws is practically straight, but on either side of it on the upper jaw there is a distinct concavity, corresponding to a similar convexity of the lower jaw. The teeth are nearly white; a single stout transverse ridge runs across the centre of each (unworn) tooth, separating two equal convex surfaces, each of which is strongly corrugated longitudinally. There are normally four processes on the floor of the mouth as in *T. uarnak*, but the two central ones are much stouter than the lateral ones and somewhat widely separated from them.

Although I have not been able to examine so large a series of this species as I have been able to examine in the case of *T. uarnak*, I have seen a considerable number of specimens. *T. gerrardi* is well represented in the collection of the Indian Museum and is commonly sold in the Burmese coastal markets during the winter months. A considerable number of specimens was taken off the coasts of Burma, Chittagong and Orissa by the "Golden Crown" in the late summer and autumn of last year and in the winter of this. Apparently the species is only taken in shallow water, at any rate in winter.

Trygon favus, sp. nov. (Pl. i, fig. 3; pl. iii, fig. 10.)

Closely allied to *T. uarnak*, from which it may be distinguished by the following characters:—

Size moderately large (type (♀) 130 cm. across the disk).

Disk very flat, with the pectoral fins even more broadly rounded than in *T. uarnak*, and the snout somewhat more produced; its length about $3\frac{2}{5}$ in the total length of the disk. Eyes widely separated, small.

Tail rather less than twice as long as the disk.

Colour.—Dorsal surface very dark brown with a bold reticulation of dull yellow, which becomes less regular on the fore part of the disk than it is on the hind part.

A yellow spot or streak in the middle of most of the meshes of the reticulation. Ventral surface white.

Skin devoid of denticles with stellate bases.

Mouth large. Jaws as in *T. gerrardii*. Teeth white ; the transverse ridge feeble even on the unworn teeth. On the floor of the mouth there are two bluntly triangular processes with irregularly serrated margins and joined together by a similarly serrated ridge.

I have only seen two specimens of this species, both females. They were taken together off the coast of Orissa in October by the "Golden Crown." In spite of their striking coloration I was inclined to regard them as representing a variety of *T. uarnak*, until I came to examine the interior of their mouths and to analyse the measurements of both forms. Unfortunately only the two mouths and the skin of the back of one specimen could be preserved. One of the mouths, and this piece of skin, therefore, constitute the "type," which is numbered F $\frac{2\,4\,1\,1}{1}$ in the registers of the Museum.

A good photograph of the specimen of which these relics have been kept is given on pl. i, fig. 3.

Trygon bleekeri, Blyth. (Pl. iii, fig. 9.)

T. bleekeri, *Day, Fishes of India*, vol. ii, p. 738, pl. cxcv, fig. 3 ; *Faun. Brit. Ind., Fishes*, p. 54.

Size fairly large (adults 112—119 cm. across the disk).

Disk slightly broader than long. The snout narrow, acutely pointed, strongly produced, measuring more than $\frac{1}{3}$ of the total length of the disk and twice as long as the distance between the eyes.

Colour.—Dorsal surface dark brown, unspotted. Ventral surface in young white with a broad margin of dark brown. As the fish grows, this margin becomes broader and finally occupies nearly the whole of the disk. In some adult specimens a distinct streak remains in the middle of the disk ; in others this is more or less obscured by dark blotches or disappears almost completely. There are no pale rings on the tail.

Skin.—The scales closely resemble those of *T. gerrardii* in structure and arrangement.

Mouth.—Jaws distinctly undulated, the central part of the upper jaw forming a narrow, conical downward projection, and the lower jaw having a corresponding concavity in the middle. Teeth dark reddish brown, having a single transverse ridge, which is very distinct on the unworn teeth and divides them into two equal convex surfaces marked with longitudinal corrugations. On the floor of the mouth there are two long finger-like processes nearer one another than either is to the angle of the mouth but rather widely separated (pl. iii, fig. 9).

This species is allied to *T. gerrardii* (which it resembles in the nature and arrangements of its denticles very closely) even more nearly than it is to *T. uarnak*. As regards the processes in the mouth the latter species seems to be at one extreme of a series of which *T. bleekeri* is at the other.

A considerable number of specimens of *T. bleekeri* were taken by the "Golden Crown" in October off the coast of Burma and Orissa. Most of the specimens I have seen have been females, as is also the case as regards *T. uarnak*. The two species are often taken together. Both seem to be commoner in the northern parts of the Bay than off the Madras coast. This is especially the case as regards *T. bleekeri*, which, indeed, has not been taken by the "Golden Crown" except in the north. Both species apparently prefer a muddy bottom.

Trygon alcockii, sp. nov.

Size considerable (adult female 85 cm. across the disk).

Disk slightly broader than long, with the pectoral angles rounded; the length from the maximum diameter to the tip of the snout contained about $2\frac{1}{4}$ times in the length of the disk. The snout pointed, forming approximately a right angle, by no means strongly produced but considerably longer than the interorbital distance; its length contained nearly $4\frac{1}{2}$ times in the length of the disk.

FIG. 3.—Outline of *Trygon alcockii*, × *c.* $\frac{1}{10}$.

Tail nearly cylindrical but somewhat flattened above at the base, tapering, not twice as long as the disk, without cutaneous folds, bearing a single large spine.

Colour.—Dorsal surface dark olive-brown with small, obscure, pale spots scattered all over the disk and the base of the tail; the edges of the fins purplish; the dorsal and lateral surfaces of the tail brown, without markings except at the base. Ventral surface (including base of tail) white, suffused with pink; a rather broad purplish lateral margin marbled with white.

Skin tough. The scales flat and more or less rounded, differing greatly in size on different parts of the head and body, to which they are confined on the disk; the largest occurring in a small patch behind the shoulder girdle; those between the eyes and on the middle of the posterior part of the back and the base of the tail larger than those on the central part of disk, where they are so small and so deeply sunk in the skin that they are almost invisible in the fresh specimen; the tail completely covered with flat scales except as regards the ventral surface of the part anterior to the spine; this surface, the pectoral and pelvic fins bare.

Mouth small; the jaws distinctly but not strongly undulated. The teeth white, with a single distinct central transverse ridge, larger on the upper jaw at the sides than in the middle, not occupying the whole of the exposed surface of either jaw.

Two individuals were taken in a seine-net at Puri on March 21st during a short visit to the Orissa coast made by Dr. Jenkins and myself. One had already been cut up before the specimen could be secured, but the other (a female) has been preserved. It is the type of the species, and is numbered F $\frac{2}{1}\frac{4}{}\frac{7}{}\frac{4}{}$ in the books of the Indian Museum.

This ray is distinguished from *T. jenkinsii* by its flat scales, by its proportions, and by its coloration. The difference as regards the last point is not, however, very marked, for the pale spots are faint and soon disappear in preserved specimens, while the coloration of the ventral surface was perhaps due to some extent to suffused blood. From *T. gerrardii*, *T. alcockii* is distinguished by its larger size, shorter and stouter tail, and differently proportioned disk, as well as by the fact that its spots are scattered on the anterior as well as the posterior part of the body.

As regards the processes on the floor of the mouth in *T. alcockii*, I am not in a position to give a description of their normal characters, because in the one specimen I have examined they are markedly asymmetrical. I may say, however, that there are, in this specimen, four blunt processes situated at about equal distances from one another. One of them is much longer than the others.

The type of the species was certainly mature and had probably just given birth to a young one as the nutritive filaments in one uterus were highly developed.

Trygon jenkinsii, sp. nov.

Size moderately large (adult male 103·75 mm. across the disk).

Disk considerably broader than long. The pectoral angles rounded; the length from the greatest diameter to the tip of the snout $2\frac{1}{2}$ times in the length of the disk. The snout sharply pointed, not much produced, longer than the distance between the eyes, which are large and prominent; the length of the snout contained $3\frac{1}{2}$ to 4 times in the length of the disk.

Tail cylindrical throughout, without a trace of a cutaneous fin, not much longer than the disk is broad, sometimes bearing two serrated spines, which are long and slender.

Colour.—Dorsal surface reddish olive, becoming paler at the edge of the fins, without definite markings. The tail dark grey, mottled on the ventral surface with brown and white at the base. The ventral surface of the disk dead creamy white.

Skin fairly tough. A few enlarged rounded denticles in the scapular region followed posteriorly by a single row of stout, short, retroverted spines with flat bases, the row extending on the tail to the base of the anterior spine; the middle of the back occupied by a pavement of small, flat, round scales, which gradually become smaller towards the periphery. The pectoral and pelvic fins naked; the tail covered with small, bluntly spinous tubercles.

Mouth.—Jaws feebly undulated; teeth white, practically uniform in size, each with a low transverse ridge situated near the posterior margin and with a distinct trans-

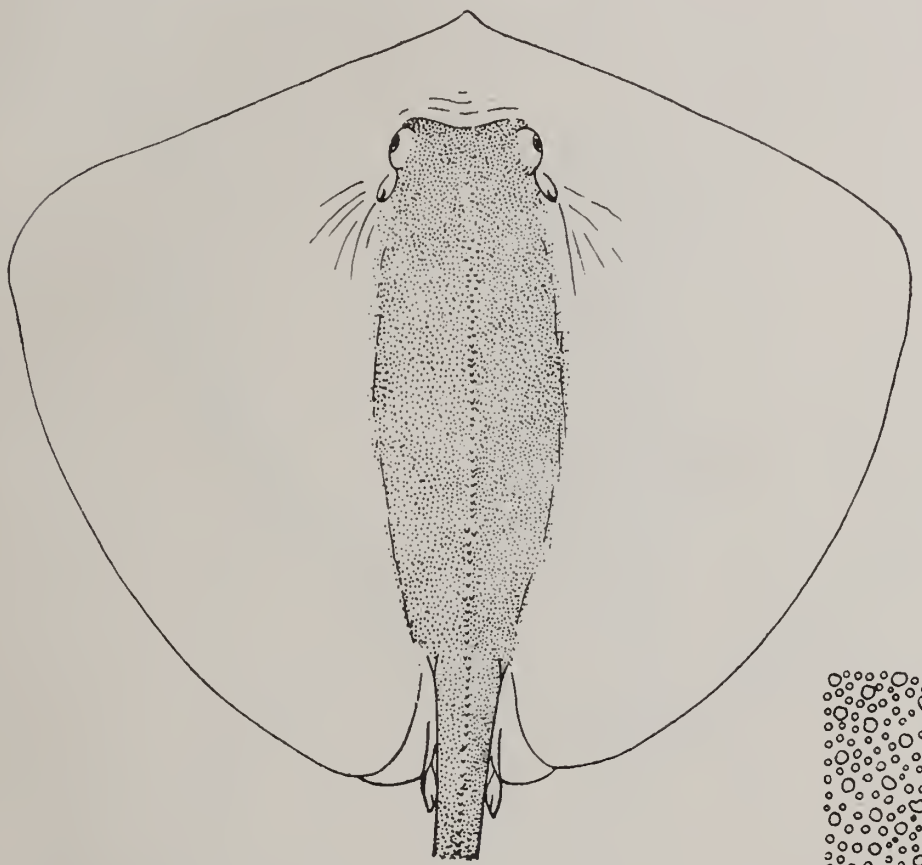


FIG. 4.

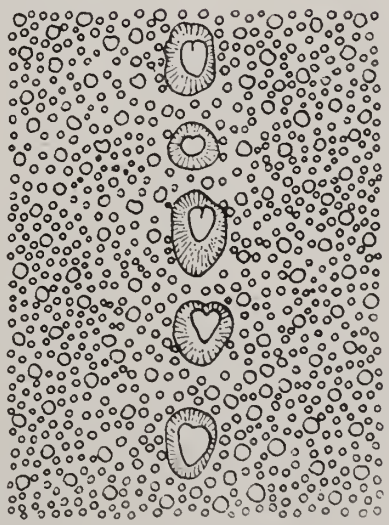


FIG. 4*a*.

FIG. 4.—Outline of fresh specimen of *T. jenkinsii*, × *c.* $\frac{1}{9}$.

,, 4*a*.—Scales on the middle of the posterior part of the back of the same specimen, × $1\frac{1}{2}$.

verse depression in front. Processes on the floor of the mouth four in number, resembling those of *T. gerrardii* but with the two central ones a little further apart.

This species appears to resemble *T. akajei* in several respects but to differ in size, in the proportions of the disk and tail, lepidosis and character of the teeth and jaws. Possibly it may be identical with Bleeker's *Trygon dadong*, but on the whole I think this improbable.

Two adult males were taken by the "Golden Crown" off the Ganjam coast in 23 to 27 fathoms in March, 1909. The type (dried skin, mouth in spirit) is numbered F $\frac{2478}{1}$ in the Museum registers.

To facilitate comparison I give the measurements of specimens of the six allied species, *Trygon uarnak*, *Trygon gerrardii*, *Trygon favus*, *Trygon bleekeri*, *Trygon alcockii* and *Trygon jenkinsii* together. The specimen indicated with a * was measured in spirit.

Name of species.	Sex.	Length of disk.	Width of disk.	Length of tail.	Nasal flap.	Distance between eyes.	Snout.
Trygon uarnak ..	♂	122·5 cm.	150·0 cm.	321·25 cm.	12·75 cm.	25·0 cm.	37·5 cm.
,, ,, ..	♀	120·0 ,,	152 5 ,,	438·75 ,,	15·0 ,,	23·75 ,,	32·5 ,,
,, ,, ..	♀ (juv.)	23·75 ,,	40·0 ,,	80·0 ,,	2·5 ,,	6·25 ,,	..
,, ,, ..	*♀ (embryo).	23·5 ,,	29·5 ,,	67·8 ,,	2·9 ,,	4·5 ,,	6·7 ,,
Trygon gerrardii ..	♀	55·0 ,,	67·5 ,,	150·0 ,,	5·62 ,,	10·0 ,,	15·0 ,,
Trygon favus (type) ..	♀	115·0 ,,	130·0 ,,	207·5 ,,	..	30·0 ,,	36·25 ,,
Trygon bleekeri ..	♀	118·75 ,,	117·5 ,,	202·5 ,,	8·75 ,,	15·0 ,,	32·5 ,,
,, ,, ..	♀ (juv.)	41·25 ,,	46·25 ,,	138·75 ,,	5·0 ,,	7·5 ,,	15·0 ,,
Trygon alcockii (type)..	♀	73·0 ,,	85·0 ,,	102·5 ,,	7·0 ,,	11·0 ,,	16·5 ,,
Trygon jenkinsii ..	♂	78·75 ,,	103·75 ,,	110·0 ,,	8·75 ,,	16·25 ,,	22·5 ,,
,, ,, (type)..	♂	80·0 ,,	103·75 ,,	112·5 ,,	7·5 ,,	15·0 ,,	20·0 ,,

Trygon marginatus, Blyth. (Pl. iii, fig. 2.)

T. marginatus, *Blyth, Journ. Asiat. Soc. Bengal*, xxix, p. 38 (1861); *Day, Faun. Brit. Ind.*, Fishes, p. 54.

Disk broader than long, with the pectoral angles somewhat narrowly rounded. The snout rounded as a whole, but sometimes with a short terminal projection; length of snout $3\frac{4}{5}$ to $4\frac{1}{2}$ times in length of disk. Eyes small.

Tail much longer than disk, without caudal folds. There is only one large serrated spine.

Colour.—Dorsal surface grey, with a distinct blackish tint and without any tinge of brown. In the male a series of livid bluish marks of an irregularly crescentic outline runs round the disk at some little distance from the margin. Ventral surface white with a broad blackish margin laterally and posteriorly; this margin sometimes indistinct. Tail blackish.

Mouth rather small; the lower jaw more distinctly undulated than the upper, which is nearly straight. Teeth faintly tinged with brown. The unworn teeth are distinctly but minutely ridged longitudinally; the transverse ridge is strong, and there is a well-marked concavity on the surface in front of it. There are two short processes on the floor of the mouth, one situated near each angle.

Skin.—The skin is delicate, but not so soft as in *T. microps*. The head and the centre of the back are covered with closely set, rounded, almost flat denticles, which on the tail are intermixed with stellate spines. On the back the denticles become

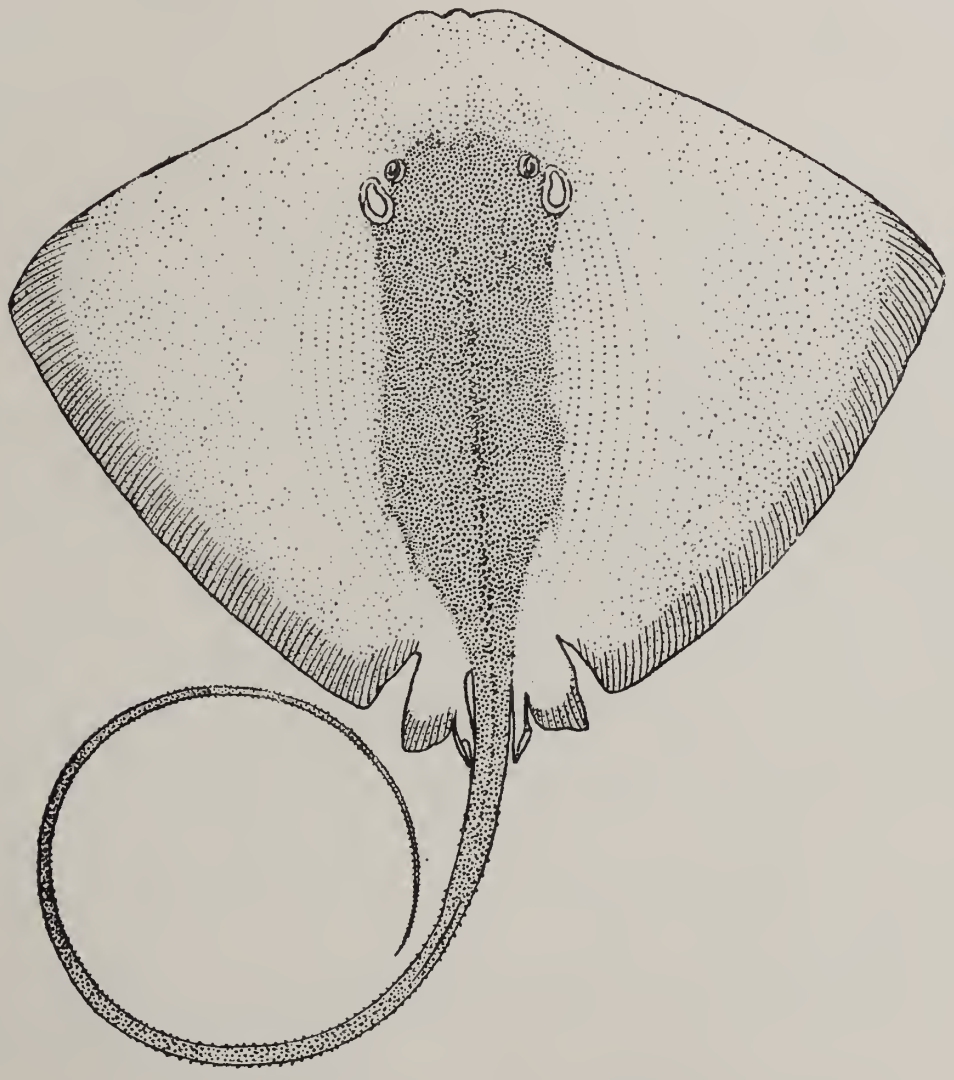


FIG. 5.—*Trygon marginatus*, ♂, × *c.* $\frac{1}{11}$. (From stuffed specimen.)

gradually smaller from the middle outwards and do not form a clearly defined figure on the area they occupy. Externally, on either side, some of them have stellate bases—a character which becomes more marked as regards those that occur on the pectoral fins, on which they show a tendency to be arranged in longitudinal lines. They extend to the margin and sometimes over it on to the ventral surface.

This description is based on a large male taken by the "Golden Crown" in October off the coast of Burma and a still larger female captured in March off the coast of

Ganjam in about 24 fathoms. Although they do not agree in every respect with Blyth's description of the species I think these specimens must belong to it. Blyth's specimens appear to have perished and there are no others, except the ones described, in the Indian Museum, or, indeed, so far as I can discover, in any other collection. The measurements of my specimens were as follows :—

	♀	♂
Length of disk	.. 147·5 cm.	102·5 cm.
Breadth of disk	.. 178·75 ,,	136·25 ,,
Length of tail	.. 197·5 ,,	220·83 ,,
Length of snout from eyes	.. 37·5 ,,	25·0 ,,
Distance between eyes	.. 26·5 ,,	21·25 ,,
Nasal flap	.. 16·25 ,,	15·0 ,,
Mouth to vent	.. 96·25	———

Trygon imbricata (Bloch and Schneider).

T. imbricata, *Müller and Henle, op. cit.*, p. 164 ; *Day, op. cit.*, p. 52.
T. walga, *Müller and Henle, op. cit.*, p. 159, pl. 51 ; *Day, op. cit.*, p. 55.

Size small (adults 210—220 mm. across the disk, young 90—100 mm.).

Disk about as long as broad in the adult, broader in the young, always with the pectoral fins broadly rounded ; the snout not greatly produced, occupying about one-third of the disk, forming an angle which is nearly a right angle ; its length from the eyes about $2\frac{4}{5}$ times the distance between the eyes. Eyes nearly as large as spiracles, not very prominent.

Tail variable in length, sometimes barely as long as the disk, sometimes twice as long or even longer, proportionately longer in the young than in the adult. On either side there is always a thick but low ridge, while along the mid-dorsal line a narrow groove can generally be detected. Sometimes this groove contains a low fold, which is much lower than the tail and is more strongly marked on the distal half of the tail than it is on the basal, although it does not reach the tip. More rarely there is a corresponding fold on the ventral surface, but even when both are present they are low and inconspicuous. As a rule there are two narrow serrated spines on the tail.

Colour.—Ventral surface white. Dorsal surface of brownish clay-colour, occasionally with obscure darker spots and usually becoming paler on the edge of the fins. The lateral ridges on the tail white.

Skin.—The lepidosis is as variable as are the proportions of the tail, but the two characters are not correlated. In many adult individuals the back and head (but not the pectoral fins) are covered with small flattened denticles which do not differ from one another markedly as regards size or shape. There are sometimes, however, several enlarged tubercles on the midline of the scapular region, while often a row of denticles bearing backwardly directed spines can be detected in the middle line at the posterior end of the disk and on the base of the tail. They vary in size and development. Sometimes, even in adults, the disk is almost naked.

Mouth.—The jaws are somewhat curved as a whole and regularly but not very strongly undulate. The teeth are small and white; the transverse ridge is low and

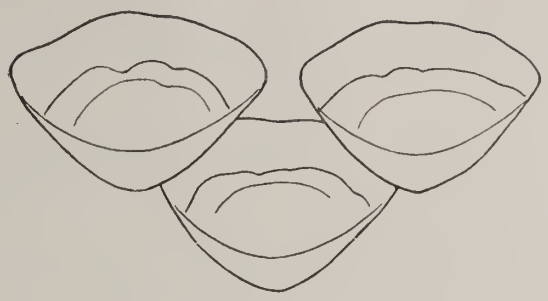


FIG. 6.—Teeth of *Trygon imbricata* (enlarged). From preparation in canada balsam.

somewhat irregular, the surface of the tooth posterior to it being decidedly concave. There are two short processes on the floor of the mouth, occasionally with a minute papilla between them. They are situated much nearer to one another than either is to the angle of the mouth.

At first sight the form described by Bloch and Schneider as *Raja imbricata* is very distinct from Müller and Henle's *Trygon walga*. Indeed, so long as I had only examined a comparatively small series of specimens, I was prepared to regard them at least as distinct varieties. Recently, however, I have had an opportunity of examining a large number of living specimens, among which I find every gradation between the two forms. Shortness of tail is not invariably or even usually correlated with any peculiarity in the denticles, nor is the exact form of the disk correlated with either character. Every possible gradation is found between a distinct caudal fold and a complete absence of any such character. Nor is any one peculiarity peculiar to either sex. Except that the young has a relatively wider disk, a longer tail and a paler colour, and usually fewer denticles on the disk, than the adult, there is no external difference between them, and I have seen two embryos from one mother which differed considerably as regards length of tail.

T. imbricata appears to be, in the strict sense of the phrase, a littoral and estuarine species. Few specimens have been taken in water even so deep as 15 fathoms by the "Golden Crown," but large numbers are captured in the winter season on the Orissa coast at Puri by means of seine-nets worked from the shore. The flesh is only eaten by the lowest castes of the Hindus.

Trygon zugei (Müller and Henle).

Size small (largest specimen 31 cm. across disk, smallest 8·5 cm.).

Disk slightly broader than long; the pectoral angles broadly rounded; the greatest transverse diameter situated about half way between the base of the tail and the tip of the snout, which is sharply pointed and much produced, its length from the eyes being more than three times as long as the distance between the eyes. Eyes nearly as large as the spiracles.

Skin smooth, richly provided with mucous glands. Sometimes a few rudimentary denticles can be detected on the posterior part of the disk and the base of the tail, but as a rule the skin is naked except for a single mid-dorsal line of large denticles with sharp spines directed backwards. Sometimes this line is only developed on the base of the tail, sometimes it extends from a point close behind the spiracles.

Tail with low dorsal and ventral folds, which commence close behind the spine and run for about a third of the length of the tail; the tail from one-and-a-half to nearly three times as long as the body.

Mouth broadly arched as a whole; the jaws slightly sinuous. The teeth white. Each

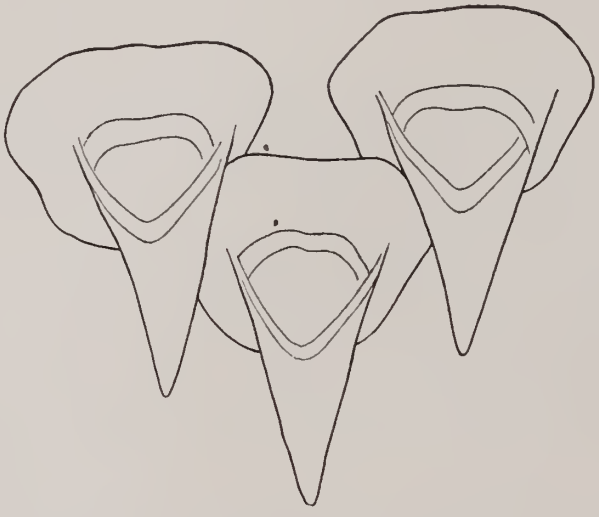


Fig. 7.—Teeth of *Trygon zugei*, ♂ (enlarged). - From preparation in canada balsam.

in the male with a roundish base and a long, slender, tapering cusp, which ends in a sharp point; in the female a triangular ridge takes the place of the cusp.

Colour.—Dorsal surface dark blackish brown, no paler at the edge of the fins than on the middle of the disk. Ventral surface white, often blotched or suffused with dark pigment. Young paler above than the adult, with the edges of the pectoral fins black on both surfaces.

P. zugei does not appear to be common in the northern parts of the Bay of Bengal but a few specimens have been taken by the "Golden Crown" off the coasts of Burma and Orissa, as well as a considerable number (in February) off that of Madras. The photograph reproduced on plate iv was taken from one of the former while it was still fresh. The freezing to which it had been subjected, however, had caused the skin to shrivel a little.

Trygon kuhlii (Müller and Henle).

Size small (male 30 cm. across the disk, female 32 cm.).

Disk slightly broader than long: the pectoral angle rounded, the broadest diameter being considerably nearer the tip of the snout than the base of the tail. The snout

rounded, not produced, its length from the eyes not much greater than the distance from eye to eye. Eyes very large and prominent. Spiracles narrow, extending along the outer margin of the eyes.

Tail considerably longer than the disk, armed with two or more long, slender serrated spines and bearing a long, well-developed ventral cutaneous flap and a much shorter dorsal one.

Colour.—Dorsal surface pale slate-colour ornamented with a variable number of round, bluish, black-edged spots scattered irregularly, and sometimes with smaller black spots. Ventral surface white. The proximal part of the tail rather darker than the ground of the dorsal surface of the disk, without markings; the distal part boldly banded with black and white.

Skin almost naked, sometimes bearing numerous minute rudimentary denticles on the tail and in the middle of the back. A row of large denticles with stout spines directed backwards sometimes present in the mid-dorsal line, but, at any rate in young individuals, not always present.

Mouth.—Straight as a whole; the jaws distinctly undulate. The teeth resembling those of *P. zugei* but with a considerably stouter cusp in the male. The nasal flap straight, fringed, with a longitudinal central groove on the surface.

No specimens of this species have been taken by the "Golden Crown" in the northern part of the Bay of Bengal, but a large pair (♂, ♀) and several smaller specimens were captured in February, 1909, off Gopalpur (Madras Coast) in 24 fathoms and a considerable number of specimens of different sizes off the same coast in March. Both *P. zugei* and the present species have a wide range, the former being distributed from the Arabian Sea to Japan, while the latter occurs not only in Japanese waters but also on the East Coast of Africa.

Genus HYPOLOPHUS, Müller and Henle.

Distinguished from *Trygon* by the form of its tail, jaws and teeth.

Hypolophus sephen (Forskål).

Trygon sephen, *Day, Faun. Brit. Ind.*, Fishes, i, p. 51, figs. 21, 22.

Size large (adult 152 cm. across the disk).

Disk slightly broader than long, with the pectoral angles obtusely rounded; the broadest transverse diameter widely separated from the anterior end of the disk. Snout forming an angle greater than a right angle; not produced. Eyes large and prominent.

Colour.—Dorsal surface reddish brown in the young, bluish grey in the adult, without spots; the margins of the fins and the tail (except the base) darker than the centre of the disk.

Tail.—Longer than disk in normal specimens, with a broad cutaneous flap running along the ventral surface from a point near the insertion of the serrated spine (or spines) for about one quarter of the length of the tail, its distal extremity being widely separated from the tip. Two serrated spines are usually present.

Skin tough. The head, back and base of tail are covered with closely set, flat or nearly flat denticles, usually with three or more enlarged tubercles in the scapular region. The tail is covered for the greater part of its length with small spiny denticles, which also occur scattered on the cutaneous flap.

Mouth.—The jaws are bent almost angularly, this being particularly noticeable as regards the upper jaw, in the middle of which the teeth are smaller than they are elsewhere. The middle part of the upper jaw is deeply concave from below. The teeth are white ; their surface is nearly smooth and the transverse ridge is practically obsolete. Where they are quite unworn, however, it is possible to see that the surface is divided into two areas ; a posterior one, of which the outline is rounded and the surface obscurely sculptured, and an anterior one with an angular outline and marked with distinct longitudinal grooves. On the floor of the mouth there are three long slender processes situated close together in the middle, and another near each angle.

This species represents the genus *Hypolophus* of Müller and Henle and is certainly very distinct from any other. I am doubtful as to the necessity for recognizing sub-genera in the fishes, otherwise I would certainly recognize Müller and Henle's name as that of a sub-genus.

There are several small specimens in spirit in the collection of the Indian Museum, but the only fresh one that I have seen was a male measuring 151·8 cm. across the disk which was taken by the "Golden Crown" in August off the Burmese coast. This specimen exhibited an interesting abnormality, lacking the distal part of the tail completely. The cutaneous flap ran to the extreme tip, becoming gradually lower towards this point. The tail, however, was no longer than the disk, and I have little doubt that it had been accidentally abbreviated, although the wound had completely healed without even leaving a scar at the tip. A photograph of this specimen is reproduced on plate v, fig. 1.

Genus Urogymnus, Müller and Henle.

Tail very distinct from the disk, without a serrated spine. Disk stout, elliptical or subcircular. Teeth flattened, without a distinct transverse ridge but with the inner margin raised. Other characters as in *Trygon.*

Hitherto only one species of the genus has been known, namely *Urogymnus asperrimus* (Bloch and Schneider), but a second is here described. Unfortunately I have only seen one fresh individual of the former, which was mutilated, and have not been able to examine the latter except as a stuffed museum specimen. The differences, however, are so very clearly marked that I do not hesitate to describe the new species.

The two species may be distinguished as follows :—

A. Pectoral fins covered with spiny denticles which have flat circular bases .. .. *U. asperrimus.*

B. Pectoral fins covered with small rounded denticles, which at the periphery are almost granular .. *U. lævior.*

Urogymnus asperrimus (Bloch and Schneider).

Disk slightly broader than long, broadly arched in front but with a somewhat projecting snout, very thick vertically in the middle, sloping up abruptly from the anterior part of the pectoral fins to the top of the head.

Tail longer than disk, sometimes with a low cutaneous fold on the ventral surface.

Colour uniform greyish brown on the dorsal surface.

Skin tough, very richly supplied with slime-glands. The head, back and tail are densely covered with prominent bony tubercles, among which are scattered numerous spiny denticles with more or less stellate bases. These are particularly numerous on the tail and on the superciliary part of the head. The pectoral fins are covered with spiny denticles which have smooth circular bases. In the dried skin the area on which the bony tubercles are present is clearly marked off from that occupied by the spines with circular bases, but in the fresh specimen the bases of all the scales are more or less completely concealed in the epidermis and in the enormous amount of slime with which the skin is coated.

Mouth.—The upper jaw is divided by a shallow concavity on either side into three nearly equal convex projections. The middle part of the lower jaw, however, is nearly straight, there being a slight concavity on either side. The teeth are of a dark purple-brown; they are nearly oval (transversely) in shape and have the exposed surface minutely but deeply sculptured. On the floor of the mouth there are three long finger-shaped processes situated close together in the middle.

The only specimen I have seen fresh was captured by the "Golden Crown" in August, 1908, off Chittagong, but there are several stuffed ones in the Madras Museum. The one taken by the "Golden Crown" had lost the greater part of its tail owing to what appeared to be a slanting cut from above as with an axe. The wound had, however, healed. The following are the measurements of this specimen, which was a female :—

Length of disk	.. ..	.. 112·5 cm.
Diameter across disk	.. .. ..	.. 97·5 ,,
Distance between eyes	.. .. ..	.. 23·75 ,,
Tip of snout from eyes	.. .. ..	.. 23·75 ,,

Urogymnus lævior, sp. nov.

[*Description of type (a stuffed skin) in the Madras Museum.*]

Disk broadly oval if the pelvic fins are included, almost as wide as long without them, truncated in front as a whole, but with a short projecting snout.

Tail longer than disk, without cutaneous folds.

Skin.—Dorsal surface of pectoral fins, head and anterior part of body covered with small, round, blunt tubercles, which become gradually smaller from the centre of the body outwards towards the edge of the pectoral fins, where they are almost granular. Behind the scapular region these tubercles are mixed with short spines, which have stellate bases and become more numerous on the base

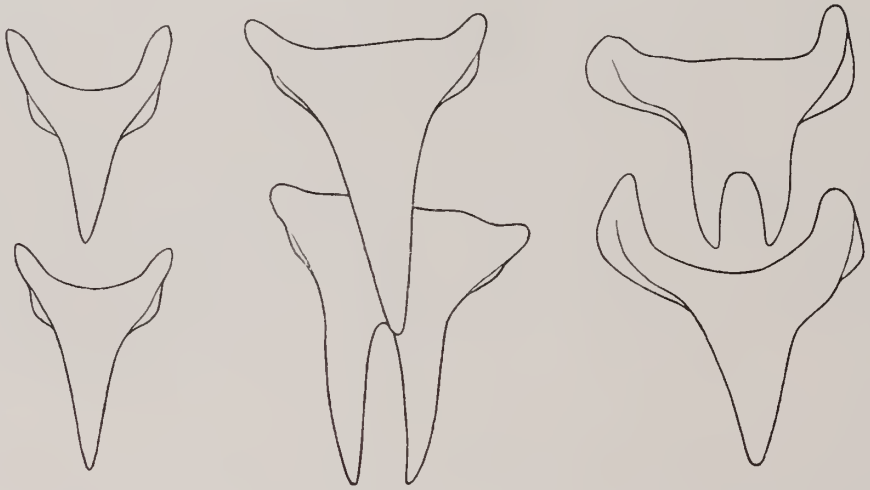
of the tail, where they greatly outnumber the rounded tubercles and finally take their place altogether. The whole of the tail is covered with spines of various sizes.

Mouth.—Upper jaw more distinctly undulated than the lower. Teeth white, practically lozenge-shaped.

This specimen was taken near the shore at Malpe, S. Canara, on the Malabar coast. Mr. E. Thurston has kindly given me the following note as to its history :— "I was summoned from the dinner-table to inspect the carcase of an immense skate, whose last act, as she lay dying on the shore, was to continue the species by bringing forth twelve young ones, who were promptly salted."

Genus Pteroplatea, Müller and Henle.

Disk very broad in comparison with its length, lozenge-shaped, flat. Pectorals united in front. Tail feeble, normally with a serrated spine, without a rayed caudal fin, a small rayed dorsal fin sometimes present. Teeth with a saddle-shaped base and one or more backwardly-directed, sharp cusps. No processes on the floor of the mouth. Nasal valves coalescent. Skin naked or nearly so.



A. B. C.

Fig. 8.—Teeth of *Pteroplatea* (enlarged) : A, *P. micrura*; B, *P. zonura* ; C, *P. tentaculata.*

Day describes only one Indian species of this genus, but three are common in the Bay of Bengal, namely, *P. micrura*, *P. zonura* and *P. tentaculata*. They may be distinguished as follows :—

I. No dorsal fin.

A. No tentacle on the posterior margin of the spiracle. Dorsal surface uniformly coloured in the adult .. .. *P. micrura.*

II. A small dorsal fin on the tail.

A. No tentacle on the margin of the spiracle. Dorsal surface minutely dotted with dark green and boldly spotted with greenish yellow *P. zonura.*

B. A small tentacle present behind the spiracle. Dorsal surface spotted and blotched with greenish yellow .. .. *P. tentaculata.*

In general form and structure all the species of the genus are very much alike. In the Indian species at any rate the structure of the mouth and teeth differs little. The mouth is nearly straight and bears no processes on its floor or cutaneous flap on its roof. The teeth have been briefly described by several authors; Günther (*Cat. Fishes*, viii, p. 486) says that they are "very small, uni- or tricuspid"; Müller and Henle describe them as "mit 1—3 Spitzen" (*Syst. Beschr. d. Plagiostomen*, p. 168); Jordan and Everman (*Fishes of North America*, i, p. 86) do not mention them in their account of the North American species. They are so small in the Indian forms that it is impossible to examine them properly without dissecting them out and mounting them for microscopic investigation. The figure reproduced on page 38 gives an outline of teeth of *P. micrura*, *P. zonura* and *P. tentaculata*. In the two latter species teeth with one cusp are mingled indiscriminately with teeth bearing two cusps; but apparently in *P. micrura* all the teeth have one cusp. In the two former species the unicuspid teeth are much more numerous than the bicuspid ones.

I have not detected any rudimentary denticles in the skin of the Indian forms.

The species of *Pteroplatea* are eaten by some castes of Hindus but rejected by others and by Mahommedans as being "fish without fins."

Pteroplatea micrura (Bloch and Schneider).

Size moderate (adult females 74—82 cm. across disk, males (?) smaller, young 16 cm.).

Disk as a rule rather less than twice as broad as long, with the pectoral angles subacute in the adult, distinctly rounded in the young. The snout hardly projects at all, the anterior margin of the disk forming a very obtuse angle. The distance between the eyes considerably greater than the length of the snout measured from them. The nasal flap distinctly emarginate, delicately fringed.

Tail variable in length, sometimes longer than disk, as a rule shorter, but always more than half as long, without dorsal fin or cutaneous folds; serrated spine usually present in the adult but absent or concealed in the young.

Colour.—The dorsal surface of the new-born young is of a pale greenish grey profusely covered with small, round, blackish spots and with more sparsely scattered and larger white ones. The ventral surface and the tail are white, but there is a row of relatively large, longitudinally oval, blackish spots on the dorsal surface of the latter. Soon after birth the spots disappear from the body, while those on the tail coalesce in pairs and grow round the greater part of the circumference of the tail. A white spot is, however, left in the middle of each of the double black ones on the tail. As the fish grows older the tint of the dorsal surface darkens to deep slate-colour or brownish grey, the spots on the back having completely disappeared before this happens although those on the tail become more distinct and more extensive with age.

This species is more commonly captured by the methods employed by Indian fishermen than its two congeners, because it is mainly a littoral form. Large numbers of small individuals were taken at Puri in January and February practically on the beach.

Day states, on the authority of Jerdon, that *P. micrura* grows to 6 feet across the disk (*Fishes of India*, ii, p. 741); but in the large series of specimens taken by the

"Golden Crown" the gravid females have measured less than 3 feet across the disk, while the adult males have all been smaller. The members of the genus are so closely allied that it is not improbable that a large species not yet described exists in Indian seas. Day refers also to a drawing in Sir Walter Elliot's collection of an example covered all over with small brown spots. Probably the original of this drawing was a young specimen of *P. zonura*.

P. micrura appears to be common off the coasts of Burma, Chittagong and Orissa at all seasons, but always to remain in very shallow water. Like its two Indian congeners it is gregarious; so far as can be judged from the specimens in the "Golden Crown" collection sent to the Museum, the shoals of the three species keep separate from one another. *P. micrura* is rather widely distributed in Indo-Malayan seas.

Pteroplatea zonura (Bleeker). (Pl. iv, fig. 4.)

Size moderate (adult females 85 cm. across disk, males slightly smaller).

Disk.—Proportions almost as in *P. micrura*. Nasal flap almost straight, barely fringed. Disk often with a distinct though short projection in front.

Tail variable, often more than half as long as disk but probably never quite so long. Dorsal fin twice as long as high, about a third as long as the free part of the pelvic fins; its anterior border situated slightly in front of the distal border of these fins. Serrated spine minute or absent. A low cutaneous fold sometimes present on the ventral surface.

Colour.—Dorsal surface olive-green, minutely and closely speckled with dots of a darker shade, boldly marked with large round or irregular spots of greenish yellow and often joined together by irregular lines and blotches of the same colour, sometimes ocellate. In the young the dark spots are paler and less numerous, while the spots are less irregular and have a brownish colour. The ventral surface is devoid of pigment. Tail coloured like that of *P. micrura*.

This fish is evidently common on the Orissa coast in depths of from 15 to 20 fathoms. Numerous individuals of both sexes have been taken there by the "Golden Crown" at different seasons, especially in winter. I saw a young female taken in the seine-nets on the beach at Puri in February.

The species was originally described from Java.

Pteroplatea tentaculata (Müller and Henle). (Pl. iv, fig. 4.)

Size moderate (adult females 73 cm. across the disk).

Disk a little less than twice as broad as long in the adult, more than twice as broad in the young; the pectoral angles somewhat rounded in both. The distance between the eyes as a rule nearly the same as (a little greater than) the length of the snout measured from them. The snout has a distinct though short projection. The tentacle at the posterior angle of the spiracle is variable in length, always slender and pointed.

Tail variable in length, as a rule less than half as long as the disk in the adult, sometimes with faint dorsal and ventral cutaneous folds. The dorsal fin about

twice as long as high, more than half as long as the inner edge of the pelvic fins; its anterior border situated nearer the base than the distal end of the pelvic fins. Serrated spine minute or absent.

Colour.—In the young the dorsal surface of the disk is of a greenish slate-colour, marked with irregular roundish spots of a dark brown, and with a faint and close reticulation of a paler shade of brown. This reticulation separates closely set roundish areas of the ground colour. As the fish grows, the brown spots enlarge and assume a greenish colour, finally becoming dark olive and occupying the greater part of the surface. The faint reticulation disappears and large spots and blotches of yellowish green are developed. The tail is faintly barred at all ages. The coloration of the adult, therefore, differs from that of the adult *P. zonura*, so far as the dorsal surface is concerned, in the absence of minute dark dots and in the faint markings of the tail. The ventral surface of the young is white, but in the adult it is marbled and clouded with dark pigment.

This species is probably confined to water from 15 to 30 fathoms deep. A considerable number of specimens were taken together in about 30 fathoms at the mouth of the Eastern Channel of the river Hughli in February, 1909. Others were taken off the Orissa coast in the autumn of 1908, but never many at a time; several were taken off the Ganjam coast in from 24 to 27 fathoms in March.

The species probably is widely distributed in the Red Sea and the Indian Ocean.

Family TORPEDINIDÆ.

Naked Batoidei with a broad, flat, circular or elliptical disk. At least one dorsal fin usually present (absent in one genus). A honeycomb-like electric organ developed between the head and the pectoral fins.

Two genera of Torpedoes are recorded by Day as occurring in Indian seas, while a third has since been described by Alcock. Two more are here added, one being new and the other represented by a species not hitherto recorded with certainty from the Indian Ocean. The following key will serve to separate the Indian genera :—

I. Two dorsal fins on the tail.
  A. Eyes well developed.
    (*a*) Spiracles distinctly separated from the eyes .. .. *Torpedo.*
    (*a*^{1}) Spiracles not distinctly separated from the eyes .. *Narcine.*
  B. Eyes degenerate.
    (*a*) Pectoral fins feebly developed .. .. *Benthobatis.*

II. One dorsal fin on the tail.
  A. Pectoral fins moderately well developed .. .. *Astrape.*
  B. Pectoral fins reduced externally to mere rudiments *Bengalichthys.*

III. No dorsal fin .. .. *Temera.*

I include in this key the genus *Temera* because it will probably be found in Indian seas, having been originally taken at Penang. There is a very small specimen (of

T. hardwickii ?) in the collection of the Indian Museum, but unfortunately I have not been able to trace its history or *provenance*. The specific characters of the only known species of the genus are so imperfectly recorded that I hesitate to identify the specimen, which is both immature and faded.

Benthobatis is a deep-sea genus, but the relations between it and *Narcine* correspond so closely with those between my new genus *Bengalichthys* (which is a shallow-water genus) and *Astrape*, that I am obliged to discuss it at some length.

Both the species and the genera of the family are in some cases closely related, and it is often difficult to distinguish between them unless fresh or well-preserved material is used. This is particularly the case as regards the genera *Narcine* and *Torpedo*. Stuffed skins of these forms are practically useless for purposes of identification, unless the greatest care has been taken to preserve the natural features. The naked, glandular skin is particularly liable to become distorted, while the colour, although sufficiently permanent in spirit unless the specimens are exposed to a strong light, invariably darkens in skins, so that all the markings disappear.

The ridges or processes on the roof and floor of the mouth form in some genera as useful a diagnostic character as is the case in certain genera of Trygonidæ, but one that can only be investigated properly by dissecting out the mouth.

The Torpedoes do not appear to be used as food in India, at any rate habitually. Those caught in the seine-nets at Puri are invariably thrown away.

Genus Torpedo, Duméril.

Disk distinct from tail, which is stout, bears a well-developed caudal and two dorsal fins and has a fold on either side. Pectoral fins well developed; pelvic fins not joined behind the anus. Eyes distinctly separated from spiracles. Nasal valves confluent into a quadrangular flap. Teeth pointed, with a single cusp and a flat base; cleft of mouth wide and U-shaped.

Only one species has as yet been found in Indian seas, or at any rate definitely identified. I am much indebted to Mr. Boulenger for examining photographs of an Indian specimen of this species and confirming my identification.

Torpedo marmorata, Risso. (Pls. iii*a*, fig. 4, and v, fig. 3.)

T. galvanii, *Bonaparte*, *Faun. Ital.*, vol. iii, Pesci, plate (1832-41).

T. marmorata, *Günther*, *op. cit.*, p. 450.

Disk broadly truncated in front, broader than long, rather longer than the tail. The latter very broad at the base. The dorsal surface covered with minute wrinkles, which run longitudinally on the anterior part of the disk and transversely on the posterior. The eyes nearly as large as the spiracles, from which they are separated by a distance less than their own diameter. The posterior and lateral margins of the spiracles provided with a row of somewhat stout, irregular, conical processes.

The *mouth* is situated between two deep, rather lengthy longitudinal folds, which approach one another posteriorly and diverge anteriorly. The teeth occupy nearly

the whole of the mandibular surface ; their cusps are long and very sharp, directed obliquely backwards. There is a low cutaneous ridge behind the teeth on either jaw but no outstanding processes.

Colour.—The colour is variable in European specimens ; in the three Indian ones I have seen the dorsal surface was of a peculiar livid dark purple-brown, densely spotted with purplish buff. These markings extended over to the ventral margin of the pectoral fins ; but the greater part of the ventral surface was dull white.

The only specimen I have examined in detail is one brought by Dr. Travis Jenkins in December, 1908, from Puri, where it had been taken in a seine-net worked from the shore. In November of the same year, however, I saw a very similar specimen, which had been captured in the same way, at Quilon on the Travancore coast. Dr. Jenkins's specimen measures (in spirit) 245 mm. across the disk, which is 227 mm. long ; the tail is 173 mm. long, the total length being thus 400 mm. The specimen is a female and contained ripe ovarian eggs ; a good photograph is reproduced on pl. v, fig. 3.

Genus NARCINE, Henle.

Disk longer than broad, distinct from tail, which bears two dorsal fins and has a fold of skin along each side. Pectoral fins well developed ; pelvic fins not united behind the anus. Eyes close to the spiracles, well developed. Nasal valves confluent. Mouth tubular and protrusible ; its cleft narrow and straight. Teeth pointed, with a single cusp, which is directed backwards and in some species feebly developed.

At first sight this genus is very near *Torpedo*, from which Günther says that it "differs in having the spiracles almost immediately behind the eye." He also says that the teeth sometimes have a median point, which, however, does not project. I cannot, however, see any real difference between the two genera in respect to the teeth ; whether the "median point" projects or not is due to the position of the mouth and to the angle at which the teeth[1] are examined, while the absence of a median point is often due to its being worn away. So far as the Indian species are concerned, there is a very marked difference between the two genera in respect to the shape of the mouth, which in *Torpedo* is evidently capable of being widely opened, although it appears to be somewhat protrusible, while in *Narcine* it can be thrust out bodily as a tubular structure with a narrow, transverse, slit-like aperture.

Narcine has long been known to be represented in Indian seas by two shallow-water forms, which Day regarded as mere colour varieties, while Lloyd has recently described a deep-sea species. I feel obliged to separate the two former from one another as distinct species for reasons given below. Here I may say that Lloyd's *N. mollis* is closely related to the form I have described as *N. brunnea*, although clearly distinct from that form. It is distinguished by the uniform dark colour of its dorsal and

[1] In comparing the teeth of these genera great care must be taken to select teeth from the back of the jaws, where they have not been worn. Some of Duméril's figures (*Nat. Hist. Poiss.*, pl. xi) rather suggest that he did not adopt this precaution.

ventral surfaces, the flabby consistency of its muscular tissue, and the structure of the interior of its mouth and teeth, the cusp of the latter being very wide transversely and forming a flat triangle rather than a spine-like process.

The Indian species may be recognized as follows :—

I. Dorsal surface spotted. Dorsal fins subequal . . . . *N. timlei.*

II. Dorsal surface brown ; ventral surface white. Dorsal fins subequal . . . . . *N. brunnea.*

III. Dorsal and ventral surfaces dark brown, unspotted. Dorsal fins subequal . . . . . *N. mollis.*

The eyes in all the Indian species are large, and the margins of the spiracles are smooth.

Narcine timlei (Bloch and Schneider). (Pl. iii*a*, fig. 1.)

N. timlei *and* N. indica, *Henle and Müller, op. cit.*, p. 130.

N. timlei, *Günther, op. cit.*, p. 452; *Day, op. cit.*, vol. i, p. 45 (in part, not the figure); *Fishes of India*, vol. ii, p. 733 (in part).

Disk variable in outline, sometimes regularly oval and only slightly broader than long, sometimes considerably narrower, sometimes with the pectoral fins projecting in such a way that it becomes, even in fresh specimens, almost rhomboidal. The tail strongly developed, depressed, nearly as long as or longer than the disk ; the two dorsal fins subequal, separated by about the length of one of them ; the posterior margin of the pelvic fins reaching or nearly reaching the anterior border of the first dorsal. Extent backwards of the pectorals variable ; sometimes they fall short of the anterior margin of the pelvic fins, sometimes reach it, and frequently overlap it.

Colour.—Dorsal surface chocolate-brown (which sometimes turns to purplish grey in preserved specimens) profusely marked on the back, lateral fins and tail with large spots of a dark purple-brown colour. In the young these spots are surrounded by rather indefinite pale rings, which sometimes persist in the adult, giving them an ocellate appearance. The posterior margins of the dorsal and caudal fins are somewhat broadly, the anterior margins narrowly edged with white. Ventral surface dead white, sometimes clouded with dark pigment in large individuals.

The *mouth* can be protruded as a depressed tube measuring, in the case of a large individual, 35 mm. in length, 15 mm. in transverse diameter at the distal extremity, and 8 mm. longitudinally. The teeth occupy about a third of each jaw ; they have long, narrow, acutely pointed inner projections, which (in the unworn tooth) are nearly as long as the transverse diameter of the bases. On the roof of the mouth behind the teeth there is a pair of irregular, distinctly separated, compressed vertical processes, and on the floor a similar pair ; in both pairs the inner margins are emarginate on the basal half. The nasal flap straight, very finely and shortly fringed, with a narrow, smooth stretch in the middle.

Adult specimens measure about 34 cm. in total length and about 17 cm. across the disk.[1] Numerous specimens have been taken off the Orissa coast by the "Golden Crown," and I have recently had an opportunity of examining many living ones on the beach at Puri, where large numbers are caught daily in seine-nets worked from the shore during calm weather. Two points at once become clear as a result of the examination of fresh specimens, (1) that it was impossible to separate Henle's *Narcine indica* from *N. timlei*, Bloch and Schneider, on the ground of the shape of the disk, and (2) that the specimens examined fell into two very distinct groups separated from one another not only by colour but also by size.

As regards the first of these points, the variation in the outline of the disk is remarkably wide and does not appear to be correlated with any difference in size, sex, or coloration. It is due mainly to differences in the development of the pectoral fins, the rays of which vary greatly not only in length but also as regards their position on the body.

Another point in which variation is very marked is the size of the eyes as compared with that of the spiracles. Occasionally the eyes are nearly as large as the spiracles, sometimes they have not more than half the superficial area of these structures.

The size and proportions of the dorsal and caudal fins are also variable.

As regards the important question of coloration, variation exists as regards the size and regularity (or otherwise) of the spots on the dorsal surface, which in one set of specimens are always present.

Day, in the "Fauna" and in the *Fishes of India*, remarks that some specimens have no spots on the dorsal surface and that the absence of spots is not due to age, sex or locality. These statements are fully borne out by the large series of living and preserved specimens I have seen; but I do not think that the two forms are specifically identical and have therefore been forced to describe the immaculate one as a new species. Unfortunately it is the one figured by Day as typical of *N. timlei*.

Narcine timlei is very sluggish in its movements. I have failed repeatedly to induce it to give an electric shock even when it was in a bucket of sea-water.

Narcine brunnea, sp. nov. (Pl. iii*a*, fig. 2.)

N. timlei, *Day, Fishes of India*, pl. cxcii, fig. 3; *Faun. Brit. Ind.*, Fishes, vol. i, fig. 18, p. 45.

Closely related to *N. timlei*, from which it differs in the following characters: (1) coloration, (2) size, (3) form of the teeth, (4) outline of the free edge of the nasal flap, and (5) form of the processes in the mouth.

(1) The dorsal surface is of a warm chocolate-brown without spots, the ventral surface creamy white. A narrow margin of the latter shade runs round the disk, being more distinct anteriorly than posteriorly; the dorsal and caudal fins, as well as the lateral ones, are edged with greyish white.

[1] Day's statement that this species grows to at least 18 inches in total length (*Fishes of India*, vol. ii, p. 733) is perhaps due to a confusion with some species of *Torpedo*. Judging from old specimens in the Indian Museum, such a confusion actually existed in his diagnoses.

(2) Large individuals of either sex measure about 22 cm. in length and 11 cm. in breadth across the disk.

(3) The posterior projection of the teeth is much shorter than the transverse diameter of the base, broader and blunter than is the case in *N. timlei*.

(4) The free edge of the nasal flap has a distinct projection in the middle line.

(5) On the roof of the mouth, behind the teeth, a cutaneous ridge with irregular serrations occurs, while on the floor there is a similar ridge, with or without a notch in the middle line, but never divided into two distinct processes.

The difference in colour between this species and *N. timlei* is constant in fresh specimens, although naturally difficult to detect in faded ones. The difference in size exists as regards the smallest specimens I have seen. There are in the Indian Museum, from different localities, seven examples of *N. brunnea* which measure between 55 mm. and 70 mm. in length, and between 30 mm. and 35 mm. across the disk. None of these specimens exhibits any trace of spots on the dorsal surface or retains any external rudiment of the yolk-sac. The smallest specimen of *N. timlei* I have seen was taken by the "Golden Crown" at the mouth of the river Hughli in January, 1909. It measures 80 mm. in length and 50 mm. across the disk and has numerous large ocelli on its dorsal surface. There is a yolk-sac 23 mm. long attached to the belly, and from the general appearance of the specimen I think that it was probably born prematurely.

The structural differences between *N. brunnea* and *N. timlei* are of considerable interest, but they can only be seen distinctly if the specimens examined are dissected.

Genus Benthobatis, Alcock.

This genus, which is known from several specimens of a single bathybial species, differs from *Narcine* mainly in the degeneracy of the eyes, a character of which no trace can be detected in the only known deep-sea species (*N. mollis*) of the latter genus. The teeth are not very different from those of some species of *Narcine*.

Genus Astrape, Müller and Henle.

Tail with one dorsal fin. Eyes small but not markedly degenerate. Teeth nearly flat, with a broad, backwardly directed ridge, which is very bluntly pointed. Mouth protrusible but not tubular, the cleft nearly straight. Other characters as in *Narcine*.

Only two species of this genus are recorded by Günther: *Astrape capensis*, from the coast of S. Africa and Madagascar, with the tail distinctly shorter than the disk, and *A. dipterygia*, from the seas of India, China and Japan, with the tail and disk of about the same length.

Astrape dipterygia (Bloch and Schneider). (Pl. iii*a*, fig. 6.)

A. dipterygia, *Day, Faun. Brit. Ind.*, Fishes, p. 46, fig. 19.

Disk longer than broad, of approximately the same length as the tail, somewhat truncate in front. The pectoral fins well developed, especially posteriorly, thin

and distinct from the trunk. Eyes about half as large as the spiracles, protuberant in life, separated by a concave interspace about half as long as their distance from the anterior border of the disk. Margins of spiracles smooth.

Mouth surrounded posteriorly by a semicircular fold, about half as wide as its distance from the anterior border of the disk, provided with thick, tuberculate lips, which are discontinuous in the middle of the anterior border. Teeth occupying nearly the whole of the mandibular surface, with a broad, bluntly pointed transverse ridge. A bilobed, prong-like, vertical process on the roof of the mouth and a similar one on the floor. Nasal flap with a distinct median longitudinal groove and a median process on the free edge.

Colour.—Dorsal surface dull chocolate colour with a purplish tinge. Ventral surface, edge of disk and fins, a large oval spot on each side of the back some distance in front of the posterior margin of the pelvic fins, and a forwardly directed streak on each side of the anterior part of the tail, cream colour.

This species exhibits much the same variation as *Narcine timlei* and *N. brunnea* in respect to its fins. It has been taken by the "Golden Crown" in considerable numbers off the Orissa coast and appears to be common all over the Bay in shallow water. It is not so common as *N. timlei* and *N. brunnea*, however, and perhaps inhabits slightly deeper water.

Large specimens measure 16 cm. in total length and 9 cm. across the disk.

Genus BENGALICHTHYS, gen. nov.

Closely allied to *Astrape*, from which it is distinguished by its thick, fleshy disk, rudimentary pectoral fins, and degenerate eyes.

I think it well to separate a form represented by two individuals in the "Golden Crown" collection from *Astrape* as a distinct genus, in order to emphasize the peculiar manner in which this form has become adapted for a more or less sedentary existence. In several respects the adaptation is of a nature closely similar to that which has brought about the evolution of *Benthobatis* from *Narcine*, although the environment in which this evolution has taken place is not the same in the two cases. *Benthobatis*, as I have already pointed out, is a deep-sea form—it occurs at depths from about 400 to about 700 fathoms—and, like many deep-sea forms, has degenerate eyes. The disk, moreover, is thick and muscular and bears on the dorsal surface numerous little glandular pits; the pectoral fins are not clearly marked off from the body. In all of these points the species of *Bengalichthys* to be described immediately resembles *Benthobatis*, although it is not a deep-sea form, having been taken in only 15 fathoms. In two striking characters, however, it differs from *Benthobatis*, *viz.*, in coloration and in the number of the dorsal fins. The former difference is probably due to its environment, the latter to its ancestry; in other words, the former is an adaptive character, the latter a morphological one. A character common among deep-sea fish of all kinds is a dark and uniform coloration of both the dorsal and the ventral surface, while among the rays of shallow water it is unusual for the ventral surface to be dark, although this is the case

in a few species. The only known species of *Benthobatis* has a dark ventral surface, the only known species of *Bengalichthys* a pale ventral surface. The genera of the Torpedinidæ, on the other hand, fall naturally into several groups separated by the number (or absence) of their dorsal fins. *Benthobatis* belongs to one of these groups, *Bengalichthys* to another. There can be little doubt, therefore, that the two genera have not had the same ancestry but have become like one another owing to parallel or rather convergent lines of evolution. Although *Bengalichthys* does not live in the dark abysses of the sea, we may suppose that its mode of life is very similar to that of *Benthobatis*. Neither can be a powerful swimmer, but both, judging from the manner in which the muscles of the disk are developed, must be powerful wrigglers and squirmers. It must be remembered in this connection that the flabbiness of the flesh (*i.e.*, the muscles) of deep-sea fish which have been brought to the surface is mainly an artificial condition,[1] not one that would be apparent if it were possible to examine the fish in their natural environment. Now, quite apart from the question of the depth at which a fish lives, it is quite clear that eyes may be inconvenient to an animal which wriggles about in the mud at the bottom of the sea, and I have little doubt that both the fish under discussion live in this way, perhaps actually burrowing into the mud, through which the movements of their disks assist them to make their way. Their mouths, like those of their nearest allies in both cases, are feebly developed and probably suctorial in function. Neither they nor their allies can attack large organisms of any kind, and it is clear that their electric organs must be weapons of defence rather than offence. Perhaps both *Benthobatis* and *Bengalichthys* have become more perfectly adapted for obtaining their food by sucking it from the mud owing to the degeneracy of certain organs that are of no use for this particular purpose.

Bengalichthys impennis, sp. nov. (Pl. iii*a*, fig. 7.)

Disk stout and muscular, pear-shaped, the broader end being in front; the anterior margin broadly convex; the length about the same as the maximum transverse diameter. Numerous white glandular pits are present on the dorsal surface, on which they are arranged in much the same way as on that of *Benthobatis moresbyi*. Pectoral fins consisting externally of a fringed ridge 2—3 mm. broad near the edge of the dorsal surface of the posterior half of the disk.

Tail stout, longer than the disk; the caudal fins rounded posteriorly; the dorsal small, situated about half-way between the posterior border of the pelvic fins and the caudal. The pelvic fins distinct from the disk and apparently situated on the sides of the tail.

Colour.—Dorsal surface of disk and tail deep buff clouded with dark brown. Ventral surface, margin of disk and fins, a large oval spot on each side of the back in front of the root of the tail, a forwardly directed streak on each side of the tail, in front

[1] The muscles of *Torpedo marmorata*, however, which is not a deep-sea fish, are much more flabby than those of any species of *Narcine* (except *Narcine mollis*), *Astrape* or *Bengalichthys* with which I am acquainted.

of the dorsal fin and a backwardly directed streak on the base of the disk at either side, cream colour.

Eyes minute, deeply sunk, colourless, close to the spiracles, which have smooth edges.

Mouth closely resembling that of *Astrape dipterygia* externally; the teeth with the triangular transverse ridge somewhat more pointed than in that species. A somewhat narrow, long rectangular process on the roof of the mouth, directed backwards rather than vertically downwards, and having its distal edge sinuous but not bilobed; a similar but smaller process on the floor of the mouth.

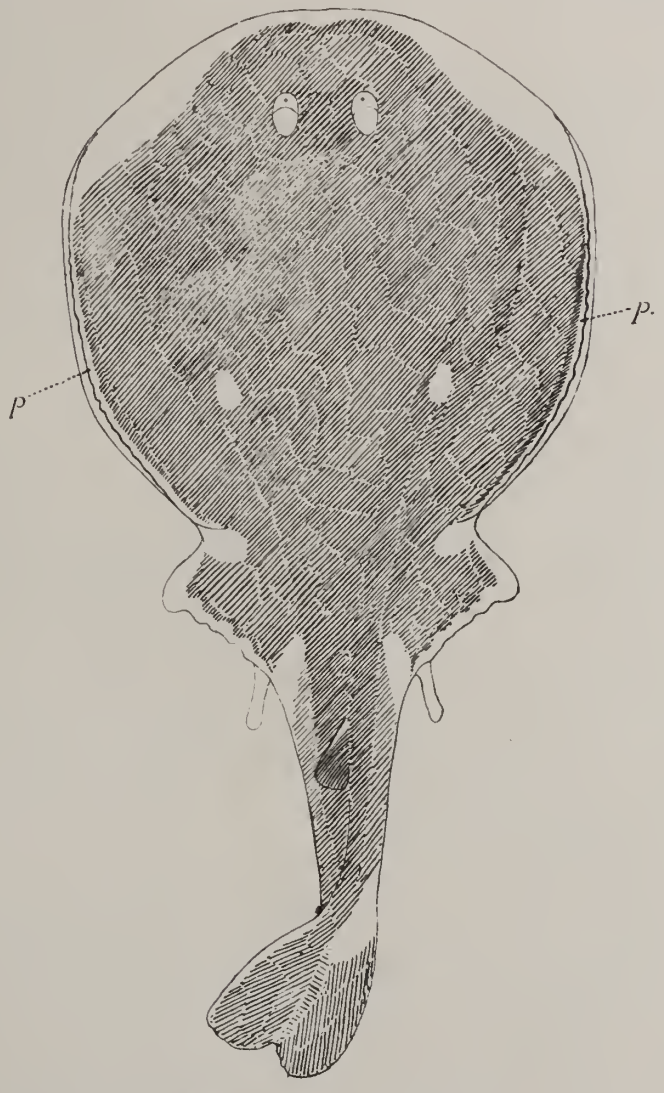


FIG. 9.—*Bengalichthys impennis*, nat. size: *p.* = pectoral fin.

This species is represented by two specimens (a male and a female) taken by the "Golden Crown" in about 15 fathoms of water in Balasore Bay on the coast of Orissa in October, 1908. The following measurements are taken from the specimens after preservation in spirit:—

	♂	♀
Total length	175·0 mm.	125·0 mm.
Length of disk	81·0 ,,	63·0 ,,

	♂	♀
Length from anterior border of anus to anterior border of disk	86·0 mm.	59·0 mm.
Length of tail	89·0 ,,	55·0 ,,
Maximum width of disk	79·0 ,,	56·0 ,,
,, thickness of disk	25·0 ,,	24·0 ,,
Distance between the eyes	6·0 ,,	5·5 ,,
,, from eyes to anterior border of disk	20 ,,	13·0 ,,
Height of dorsal fin	7·0 ,,	6·5 ,,
Length of dorsal fin	7·0 ,,	6·0 ,,

Owing to the strong muscles of the disk, it is liable to undergo great changes in shape ; the two specimens I have examined exhibit this very clearly. The degeneracy of the pectoral fins causes the disk to terminate, when viewed from above, some little distance in front of the anus.

The mouth, as in *Astrape*, is to some extent protrusible, but cannot be thrust out bodily as a tubular structure like that of *Narcine*.

The number of the type (♂) in the Museum register is F. $\frac{2\,3\,5\,7}{1}$.

Family MYLIOBATIDÆ.

Head distinct from disk, with a prominent snout or a pair of processes on the front of the head supported by two groups of cartilaginous jointed rays (cephalic fins) ; skull rectangular and box-like. Teeth flat, rectangular and pavement-like, large. Disk wide in proportion to its length. Tail long and thin, with a dorsal fin at its root, with or without a serrated spine.

Taking into consideration the great differences between the skull and teeth of the "Myliobatina" and the "Ceratopterina," I think it as well to follow Müller and Henle, and also Jordan (*Guide to the Study of Fishes*, vol. i, pp. 551, 559, 1905), in regarding them as distinct families, although I have not adopted the American name "Mobulidæ" for the latter group.

The Myliobatidæ, if this view be accepted, consist of the genera *Rhinoptera*, *Myliobatis* and *Aëtobatis*, each of which is represented by at least two species in Indian seas. Of *Rhinoptera* I have only seen the skeleton and teeth, and I do not, therefore, propose to discuss its Indian representatives. Of *Myliobatis* and *Aëtobatis*, however, the "Golden Crown" has obtained large numbers of specimens, which have afforded invaluable material for the elucidation of several doubtful points. The three genera may be distinguished by the following characters:—

I. Head provided with a pair of distinct rayed appendages (cephalic fins) on the ventral surface. Teeth tesselated, in five or more series, the central one being the broadest and the others decreasing in breadth from within outwards .. .. *Rhinoptera*.

II. Cephalic fins encased in muscle and skin to form a single more or less conical snout.

A. Teeth in a single broad series .. .. .. *Aëtobatis.*
B. Teeth in several series, of which the lateral ones are much narrower than the central one .. .. .. *Myliobatis.*

Genus MYLIOBATIS, Cuvier.

This genus is sufficiently defined in the description of the family and the generic key printed above. At least two species occur in Indian seas and have been taken by the "Golden Crown," namely, *M. nieuhofii* and *M. maculata*. A new variety of the former is described below.

Myliobatis nieuhofii (Bloch and Schneider).

Size moderately small (adults 42—64 cm. across the disk, young about 15 cm.).

Disk considerably more than twice as long as the distance between the mouth and the vent, the index $\frac{\text{vent to mouth } 100}{\text{width of disk}}$ varying from slightly over 37 to slightly over 43, but usually being between 40 and 41. The pectoral fins acutely pointed, their anterior margin nearly straight, their posterior margin broadly concave. Snout (measured from anterior borders of skull) $\frac{1}{13}$ to $\frac{1}{20}$ as long as the distance between the mouth and vent and from $\frac{1}{2}$ to $\frac{5}{7}$ as long as broad at the base, not sharply pointed.

Tail much longer than disk, without a serrated spine. The dorsal fin arises nearer the base of the pelvic fins than their distal margin and does not reach, or barely reaches, the level of that margin posteriorly.

Colour.—The fresh fish has the dorsal surface of a bright greenish golden colour with five broad cross-bars of a darker and more livid shade across the disk, and two across the head. Not only do these markings disappear in spirit or even in ice, but they are very superficial, and any rough handling causes the tissues which contain them to be rubbed away. The ordinary spirit specimen of the adult has the dorsal surface of a dark slate-grey. The cross-bars are more conspicuous in the young and remain visible longer in spirit. The ventral surface is white.

Skin soft and at first sight naked. The back, however, is more or less completely covered with minute, star-shaped denticles buried in the skin and sometimes extending on to the ventral surface. They can usually be felt by drawing the tip of the finger across the back of the disk.

Mouth nearly straight. The teeth truncate in front and not projecting from the jaw. Their proportions are very variable and the number of series of smaller teeth at the sides of the broad central one is not always the same on the two sides of one jaw. The nasal flap is always straight.

As this is one of the most variable species with which I am acquainted, I have examined and measured a large number of specimens with the greatest care. The first result of this examination was to prove that two forms of the species existed side by side, one with the area immediately above the orbits smooth, the other with a

definite ridge running along the upper limit of each orbit and produced in front into a short, horn-like structure measuring in adult specimens from 2—4 mm. in length. I cannot detect any other peculiarity that seems to be correlated with the presence of this horn, and Capt. Lloyd tells me that horned and hornless individuals are taken together in the same haul of the trawl. I therefore propose to name the horned form *Myliobatis nieuhofii*, var. *cornifera*, var. nov. (Pl. ii, fig. 4.)

The presence or absence of horns has been considered a specific character in other species of the genus, but Jordan and Snyder[1] suggest that these structures are deciduous in a Japanese species (*M. tobijei*). This is not the case as regards the Indian species. In an embryo in the collection of the Indian Museum which measures 115 mm. across the disk, the horns are already apparent, but they are absent from several other embryos of about the same size; unfortunately I have not been able to obtain a gravid female of the variety *cornifera*. In some half-grown and old specimens they are absent, in others present. In some horned individuals the denticles on the back are rather more strongly developed than is usually the case in the typical form.

The hornless form is much commoner than the horned one, but the latter is not rare. Both have been taken in large numbers off the coasts of Orissa, Chittagong and Burma, and less abundantly off the mouth of the Ganges. Apparently the species prefers a rocky bottom, on which it is possible that it finds more food in the way of molluscs. Its diet is not confined to molluscs, however, as both fish and prawns have been found in its stomach. These are swallowed whole and are not crushed by the teeth.

The following measurements are interesting as illustrating the variation that occurs as regards the teeth in this species :—

No.	Breadth of teeth of upper jaw.	Number of small teeth.		Measurements of central tooth.	
		Left.	Right.	Breadth.	Length.
1	20·0 mm.	3	3	13·5 mm.	2·25 mm.
2	16·0 ,,	3	3	11·0 ,,	2·25 ,,
3	19·5 ,,	3	3	12·0 ,,	1·75 ,,
4	17·0 ,,	3-4	2-3	11·0 ,,	1·5 ,,
5*	16·5 ,,	2	3	12·0 ,,	2·25 ,,
6	12·0 ,,	3	3	7·5 ,,	1·25 ,,
7	23·0 ,,	3	2	11·0 ,,	3·0 ,,
8	17·0 ,,	3	3	10·5 ,,	1·0 ,,
9	14·0 ,,	3	3	10·5 ,,	2·25 ,,
10	27·0 ,,	3	3	20·0 ,,	2·25 ,,

[1] *Proc. U. S. Nat. Mus.*, xxiii, p. 338 (1900).

No.	Breadth of teeth of upper jaw.	Number of small teeth.		Measurements of central tooth.	
		Left.	Right.	Breadth.	Length.
11*	19·5 mm.	3	3	12·5 mm.	1·5 mm.
12*	18·0 ,,	4	3	11·25 ,,	2·0 ,,
13	21·0 ,,	2	2	17·0 ,,	3·0 ,,
14	20·0 ,,	3	3	16·0 ,,	1·75 ,,

The numbers marked with a * refer to the specimens of the variety *cornifera*, the remainder to those of the typical form of the species.

The measurements printed above show how little reliance can be placed on exact relative proportions in diagnosing the species of the Myliobatidæ. Palæontologists in particular have attempted to separate the species of *Myliobatis* and even *Aëtobatis* by examining the relative length and breadth of the teeth. Of one species only (*M. nieuhofii*) have I been able to examine a series of adult teeth. The measurements speak for themselves. So far as the other Indian representatives of the family are concerned, most of the jaws I have examined have been those of immature specimens. So far as evidence founded on such specimens goes, however, there is every indication that variation is no less wide in the allies of *M. nieuhofii* than it is in that species.

Myliobatis maculata, Gray and Hardwick.

This species may be distinguished from *M. nieuhofii* by (1) its large size, (2) its coloration, (3) the arrangement and nature of its denticles, and (4) the shape of the snout.

(1) The size of the adult appears to be nearly twice that of the adult of *M. nieuhofii*.

(2) The young (which are often as large as the adult of the other species) have the dorsal surface of a deep bronze or greenish grey colour with rather large bluish spots scattered profusely on the posterior part of the disk. These spots are a sign of immaturity, although exactly the contrary is the case as regards *Aëtobatis punctata*. The adult *M. maculata* has the back of a uniform dark slate-grey.

(3) The most conspicuous feature of the scaling in this species is a longitudinal band, consisting of several closely adjacent rows, of flat denticles situated on the mid-line of the scapular region. The small star-shaped denticles in the skin of the back are also as a rule better developed in *M. maculata* than in *M. nieuhofii*.

(4) The snout in *M. maculata* appears to be decidedly more prominent than it is in *M. nieuhofii*, but this is largely due to the fact that its sides form a more acute angle.

I have seen comparatively few fresh specimens of this species, and only one that appeared to be an adult. It was taken by the "Golden Crown" off the Orissa coast,

but unfortunately only the head and tail were preserved. The teeth of the upper jaw measure 28 mm. in transverse diameter, but there is some evidence to show that the mouth is relatively smaller in this species than it is in *M. nieuhofii*. Judging from the analogy of the few young examples of *M. maculata* I have examined in detail, the adult specimen (a female) must have measured about 78 cm. across the disk, but in making this statement I take it for granted that there is little difference in proportions between the adult and the young of the species.

I have not seen any specimen of *M. maculata* with a superciliary horn,[1] or of either of the Indian species of the genus with a caudal spine.

Genus Aëtobatis, Müller and Henle.

This genus is separated from *Myliobatis* by the character of the teeth. In all the specimens I have seen those of the lower jaw project from the mouth in the form of a plate with parallel sides and an obtusely pointed tip. The nasal flap in these specimens is deeply emarginate. Day says that the tip of the lower tooth-band is sometimes broken off and that the free edge of the nasal flap is then straight as it is in *Myliobatis* (*Fishes of India*, ii, p. 743), but it is clear from specimens named by him that he confused *Aëtobatis guttata* with *Myliobatis maculata* in some cases.

Great confusion still exists as regards the species of *Aëtobatis*. Most recent authors, following Günther (*Cat. Fishes*, viii, p. 492), recognize only one species, namely *A. narinari*; but at least two distinct forms occur in Indian seas and it is clear that neither is the same as the American and African species.

As regards the last point, there is of course no positive proof that there are not two forms (or even more) in the Atlantic Ocean (one or more of which may be rare), as there are in the Bay of Bengal. But figures published by Duméril (*Arch. Mus.*, x, pl. 20, Paris, 1861) and by Jordan and Everman (*Bull. U. S. Nat. Mus.*, No. 47, vol. iv, pls. 37 and 38, 1900) represent a species which differs in at least two characters—namely, the shape of the snout and coloration—from any Indian specimen I have seen. Duméril shows, moreover, that the adult of the form he called *Aëtobatis latirostris*, the type specimens of which came from the mouth of the Gaboon, does not differ materially from the young as regards coloration.

Jordan, who examined specimens from Florida (*Guide to the Study of Fishes*, vol. i, fig. 349, 1905) as well as from the West Indies and Mazatlan (*Bull. U. S. Nat. Mus.*, No. 47, vol. iv, p. 2753) and found no difference between them, decided with Everman that "this species" [*i.e.*, *Aëtobatis laticeps*, Gill] "is probably not different from *A. narinari*....."

There is little doubt that *Aëtobatis laticeps*, Gill, is a synonym of *A. latirostris*, Duméril, while Euprasen (*Kong. Svens. Vet. Akad. Nya Handl.*, xi, p. 218, 1790) says regarding the species he described as *Raja narinari*:—"Habitat in India occidentali, juxta Insulas Caribæas, in portu Carenage Insulæ St. Bartholemei." The figure

[1] In a half-grown specimen taken in a seine-net on the beach at Puri in March there is a distinct but low rounded eminence on either side just in front of the eye.

(pl. x) accompanying the paper from which this quotation is taken is by no means accurate but shows the white spots extending as far forwards as the spiracles and, moreover, represents the snout as exceedingly short.

It seems indisputable, therefore, that the name *Aëtobatis narinari* belongs to the American form, which there is every reason to think was redescribed by Duméril as *A. latirostris* and by Gill as *A. laticeps*. For the common Indian form, on the other hand, the name *A. guttata* (Shaw)[1] is available. There is, however, a second Indian form, much rarer than the first in the Bay of Bengal, which, in Mr. Boulenger's opinion, is identical with Bloch and Schneider's *Raja flagellum*, and corresponds very closely with the description of that species given by Müller and Henle ("Plagiostomen," p. 180). I therefore recognize the following species in the genus: *Aëtobatis narinari* (Euprasen), *A. guttata* (Shaw) and *A. flagellum* (Bloch and Schneider). Possibly others exist.

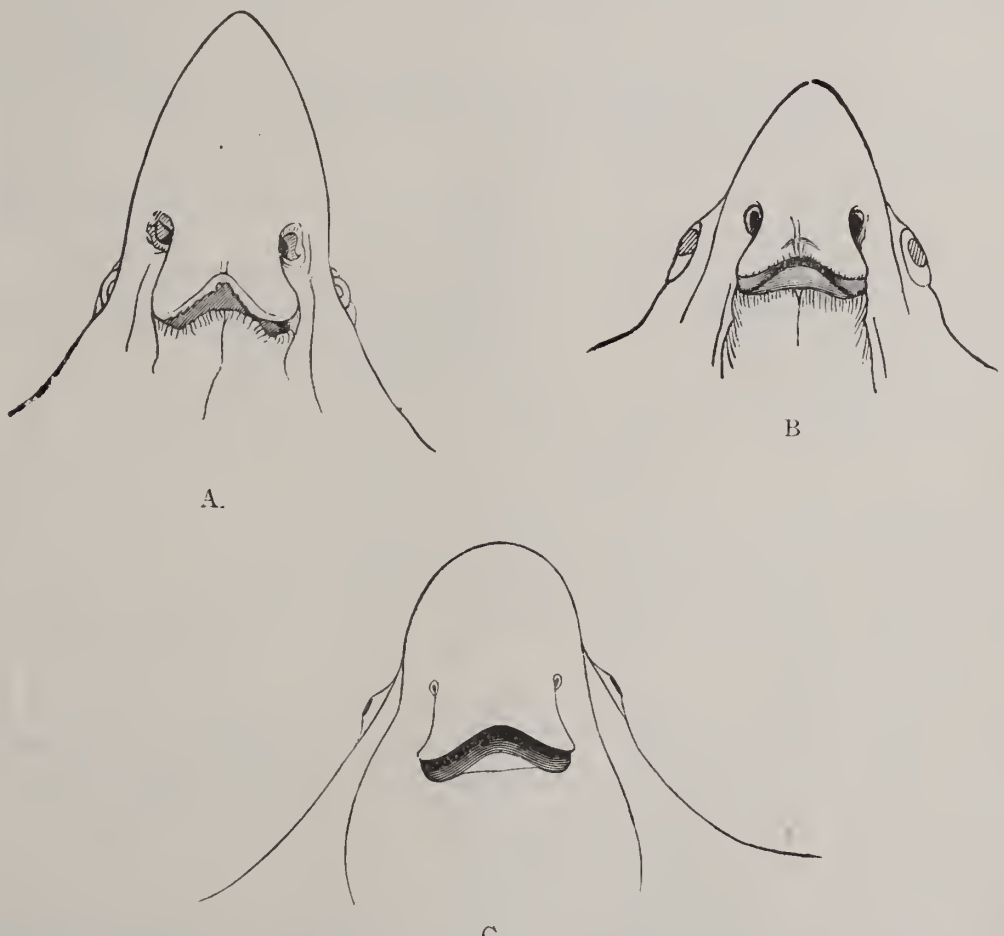


FIG. 10.—Heads of *Aëtobatis*: A, *A. flagellum*; B, *A. guttata*; C, *A. narinari* (enlarged from Jordan and Everman's figure).

[1] See Shaw's *General Zoology or Systematic Natural History*, vol. v, part ii, p. 285 (1804). Shaw did not distinguish the Atlantic from the Oriental species, and his figure of "*Raja guttata*" is quite indefinite; but as he clearly meant to include the common Indian species in his description, his name may stand.

Granted that there are three species of *Aëtobatis*,[1] it is necessary to inquire how they can be distinguished from one another. If only dried specimens are examined, the diagnosis is very difficult, if not impossible, and as regards the Atlantic form I am wholly dependent on published figures and descriptions. The following table gives the differences that are apparent from careful examination on the one hand of these figures and descriptions and on the other of fresh specimens of the Indian forms :—

Character.	*A. guttata.*	*A. narinari.*	*A. flagellum.*
Snout ..	Conical, bluntly pointed, distinctly retroverted, at least as broad at the base as long.	Rounded at the tip, much broader at the base than long, straight (?).	Pointed, straight, much longer than broad at the base.
Coloration of dorsal surface.	Uniform dark slate-grey in the young, ornamented with bluish spots, which are confined to the posterior half of the disk in the adult.	The whole disk including the head covered with whitish spots both in the young and the adult.	Disk in the adult of a uniform dark greenish bronze colour, without spots.
Size ..	Diameter of disk in adult ♂ at least 125 cm.	Diameter of disk[2] in adult ♀ 51 cm.	Diameter of disk in adult ♂ 47 cm.
Habitat ..	Tropical parts of the Indian Ocean.	Both sides of the Atlantic ; Gulf of Guinea, American coast as far north as Virginia, West Indies.	Red Sea, Bay of Bengal.

Aëtobatis guttata (Shaw).

Size considerable (adult male 125 cm. across the disk).

Disk shaped much as in *Myliobatis nieuhofii*, but quite naked.

Tail much longer than disk, always bearing at least one serrated spine, often two, sometimes three.

Colour.—Dorsal surface of young of a uniform dark slate-grey, without a trace of spots. The spots on the disk of the adult are confined to the posterior half. They are of a bluish tint and are edged with a faint greenish halo. Their size varies considerably. The ground colour of the back of the adult has, in fresh specimens, a beautiful greenish refulgence.

This is a very common species in the Bay of Bengal and, like *Myliobatis nieuhofii*, is evidently gregarious and probably also migratory in habits, at least while it is young.

[1] I am much indebted to Messrs. Boulenger and Tate Regan for examining a photograph and drawings of Indian specimens of *Aëtobatis* and for comparing them with the original figures of *A. flagellum*, which I have not been able to consult.

[2] Gilbert and Starks (*Mem. Calif. Acad. Sci.*, iv, p. 18, 1904) give the width of the disk of a specimen from Panama Bay as 615 mm. but do not state its sex.

Adults are seldom caught even in the trawl and may be solitary. I have only seen one large specimen, which was taken off the Orissa coast. Its measurements are given below.

Aëtobatis flagellum (Bloch and Schneider). (Pl. iv, fig. 5.)

A. flagellum, *Müller and Henle, Syst. Beschr. d. Plag.*, p. 180.

The differences between this species and the preceding one are noted in the table showing the specific characters of the three species of the genus. I have not been able to discover any other points that call for notice. Perhaps the tail is longer in proportion to the body; but in most large specimens of Myliobatidæ the tail is mutilated.

Müller and Henle's description is accurate, as is always the case in the work of these authors, whose monograph, in spite of the fact that it contains a certain number of specific descriptions that refer actually to the young stages of forms described as distinct, is still by far the most reliable guide as regards the identification of the Oriental Batoidei.

A. flagellum is apparently rare in the northern part of the Bay of Bengal. I have only seen two examples, a male taken by the "Golden Crown" off the Orissa coast in November, and a severed head brought from the mouth of the Chilka Lake on the same coast in December by Dr. Jenkins.

Measurements of Indian species of Myliobatis *and* Aëtobatis.

Species.	Sex.	Across disk.	Mouth to vent.	Nasal flap.	Breadth of snout at base.	Length of snout.	Tail.
Myliobatis nieuhofii ..	♀	470 mm.	190 mm.	36 × 21 mm.	51 mm.	23 mm.	Broken.
,, ,, ..	♂	354 ,,	145 ,,	30 × 17 ,,	37 ,,	25 ,,	563 mm.
,, ,, ..	♀	600 ,,	245 ,,	45 × 25 ,,	55 ,,	40 ,,	Broken.
,, ,, ..	♀	540 ,,	220 ,,	40 × 20 ,,	50 ,,	32 ,,	,,
,, ,, ..	♂	360 ,,	140 ,,	26 × 17 ,,	42 ,,	25 ,,	505 mm.
,, ,, ..	♀	510 ,,	205 ,,	35 × 19 ,,	50 ,,	35 ,,	Broken.
,, ,, ..	♀	340 ,,	133 ,,	30 × 15 ,,	42 ,,	25 ,,	,,
,, ,, ..	♂	640 ,,	260 ,,	45 × 23 ,,	56 ,,	40 ,,	555 mm.
M. nieuhofii var. *cornifera.*	♂	420 ,,	165 ,,	35 × 20 ,,	45 ,,	26 ,,	560 ,,
,, ,, ,, ,, ..	♂	445 ,,	168 ,,	35 × 20 ,,	45 ,,	27 ,,	620 ,,
,, ,, ,, ,, ..	♂	390 ,,	135 ,,	25 × 20 ,,	40 ,,	21 ,,	685 ,,
,, ,, ,, ,, ..	♂	416 ,,	153 ,,	32 × 17 ,,	42 ,,	20 ,,	610 ,,
,, ,, ,, ,, ..	♂	441 ,,	170 ,,	36 × 21 ,,	47 ,,	30 ,,	840 ,,

Measurements of Indian species of Myliobatis *and* Aëtobatis—*Contd.*

Species.	Sex.	Across disk.	Mouth to vent.	Nasal flap.	Breadth of snout at base.	Length of snout.	Tail.
M. maculata ..	♂ (juv.)	360 mm.	140 mm.	28 × 18 mm.	41 mm.	26 mm.	905 mm.
,, ,, ..	♂ (,,)	394 ,,	142 ,,	27 × 18 ,,	30 ,,	20 ,,	884 ,,
,, ,, ..	♀ (,,)	368 ,,	143 ,,	25 × 15 ,,	37 ,,	24 ,,	520 ,,
Aëtobatis guttata ..	♂ (juv.)	207 ,,	85 ,,	16 × 10 ,,	25 ,,	18 ,,	570 ,,
,, ,, ..	♂ (,,)	235 ,,	100 ,,	20 × 10 ,,	30 ,,	30 ,,	2,150 ,,
,, ,, ..	♂	1,250 ,,	..	..	..	..	..
A. flagellum ..	♂	470 ,,	205 ,,	38 × 22 ,,	52 ,,	68 ,,	985 ,,

In a future report on the Selachians of the "Golden Crown," the distribution of the Indian Elasmobranchs will be discussed. As Capt. Lloyd [1] has recently made use of all the information at present available in India regarding the Ceratopteridæ, it is unnecessary for me to discuss the species of that family, especially as no specimens have been taken by the "Golden Crown." I may say, however, that an examination of the specimens in the Indian and Madras Museums fully confirms Lloyd's remarks as to the peculiarities of the Ceratopterid skull.

[1] *Rec. Ind. Mus.*, ii, p. 175 (1908).

APPENDIX.

Analysis of the Oils produced by certain Indian Rays and other Aquatic Vertebrates.

By D. Hooper, *F.C.S., Industrial Section, Indian Museum.*

Among the specimens of fish captured by the "Golden Crown" and handed over to the Indian Museum for determination have been several species which yield large quantities of oil. The collection and use of marine animal oils in some parts of the world constitute important industries, but in India these fats are very rarely utilised, and their chemical composition and properties have never been studied. Whale and seal oils are occasionally imported for leather dressing and other purposes, and it does not appear that any serious attempt has been made to exploit the oils of Indian fish.

The first oil examined was that of the Gangetic Dolphin (*Platanista gangetica*). This animal is called *susu*, *sehu* and *sisar*, and the oil is locally used as an embrocation for rheumatism and as an illuminating agent. The oil is yellowish-brown becoming reddish-brown on keeping, has a faint fishy smell, and deposits no solid fats at the winter temperature of Calcutta (18—22° C.).

The following constants were obtained :—

Specific gravity at 15° C.	·921
Acid value	21·36
Saponification value	198·8
Iodine value	106·9
Reichert-Meissl value	·71
Fatty acids, per cent.	94·0
Melting point of	25·5° C.
Acid value of	205·0
Iodine value of	116·5

Although it is allied to the sperm whale, the oil of this animal contained no sperm-aceti. There is a fair amount of free fatty acids, but there is only a small proportion of the more volatile fatty acids. The solid fatty acid, calculated as palmitic acid, amounted to about 16 per cent. Such an oil would be of value for currying purposes, for burning and for lubricating fine machinery. The other oils examined were those of the livers of certain large fish brought from the Bay of Bengal, and identified by Dr. Annandale. The livers were from the following species :—

1. White Sting-Ray (*Trygon microps*).
2. Common Saw-Fish (*Pristis perottetii*).
3. Spotted Shark (*Stegostoma tigrinum*).
4. Shark Ray (*Rhamphobatis ancylostomus*).

The livers of these animals were of an enormous size; that of the Sting-Ray weighing 89½ pounds and that of the Saw-Fish 102¾ pounds. These livers were very rich in oil; that of the Sting-Ray afforded 71·6 parts of oil, 17·7 parts of water and 10·7 parts of hepatic tissue in 100 parts. The hepatic tissue contained over 5 per cent. of nitrogen and would form a valuable manure. All the oils deposited varying amounts of white fats, chiefly palmitin, at the cold weather temperatures. When freshly expressed the oil has a not unpleasant odour, similar to cod-liver oil, and a colour varying from light yellow to reddish-yellow.

The following constants were obtained :—

	1.	2.	3.	4.
Specific gravity at 50° C. ..	·914	·900	·910	·909
Melting point ..	22° C.	27°	26·5°	25·5°
Acid value ..	·98	1·0	1·16	1·13
Saponification value ..	194·0	187·1	185·4	187·4
Iodine value ..	124·7	92·9	123·2	118·5
Reichert-Meissl ..	·26	·28	·21	·23
Fatty acids, per cent. ..	93·2	94·7	94·2	94·6
Melting point of ..	37·5° C.	39°	39°	39°
Acid value of ..	203·4	192·2	189·9	190·4

All these oils contained a cholesterol affording a rose-red or purplish-red colour with sulphuric acid. The slight acidity of these oils is much in their favour should they be employed for edible purposes. According to Hosmann the presence of free acids is characteristic of fresh cod-liver oil. Comparatively neutral oils such as these would be much more suitable for medicinal purposes. The large quantity of solid fats would render these oils useful for soap manufacture, while the liquid oil, separated from the palmitin, would be serviceable for leather dressing, lighting and lrubicating purposes.

The livers of various fish have not the same uniform composition as the above.

The small skate known as *Trygon gerrardii* in a fresh state possessed a liver weighing only 37·5 grams. This was composed as follows in one hundred parts :—

Water	56·5
Oil	28·3
Tissue	15·2

The hepatic tissue contained 11·48 per cent. of nitrogen, an amount equal to that found in dry blood.

EXPLANATION OF PLATE I.

FIG. 1.—Photograph of a female specimen of the typical form of *Trygon uarnak* which measured 5 ft. 3 in. across the disk.

,, 2.—Photograph of a female specimen of *T. uarnak* var. *variegatus* which measured about 5 ft. across the disk.

,, 3.—Photograph of the type specimen (♀) of *Trygon favus*. This specimen measured 4 ft. 4 in. across the disk.

Fig. 1.

Fig. 2.

Fig. 3.

Photo by A.C. Chowdhary.

Fig. 1. Trygon uarnak

Fig. 2. T. uarnak var. variegatus.

Fig. 3. T. favus, sp nov.

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EXPLANATION OF PLATE II.

FIG. 1.—*Trygon uarnak* var. *variegatus* (adult female). Scale about $\frac{1}{15}$.

,, 1*a*.—*Trygon uarnak* (young). Scale $\frac{1}{4}$.

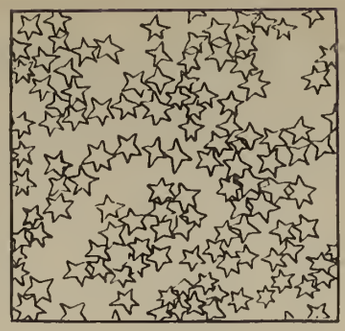
,, 2.—*Trygon gerrardii* (adult female). Scale $\frac{1}{6}$.

,, 3.—Denticles on upper surface of tail of *Trygon microps* (nat. size).

,, 3*a*.—Denticles on centre of back of same species, × 2.

,, 4.—Head of *Myliobatis nieuhofii* var. *cornifera* (nat. size).

,, 4*a*.—Denticles on back of same species, much enlarged.



×2

Fig. 3a.

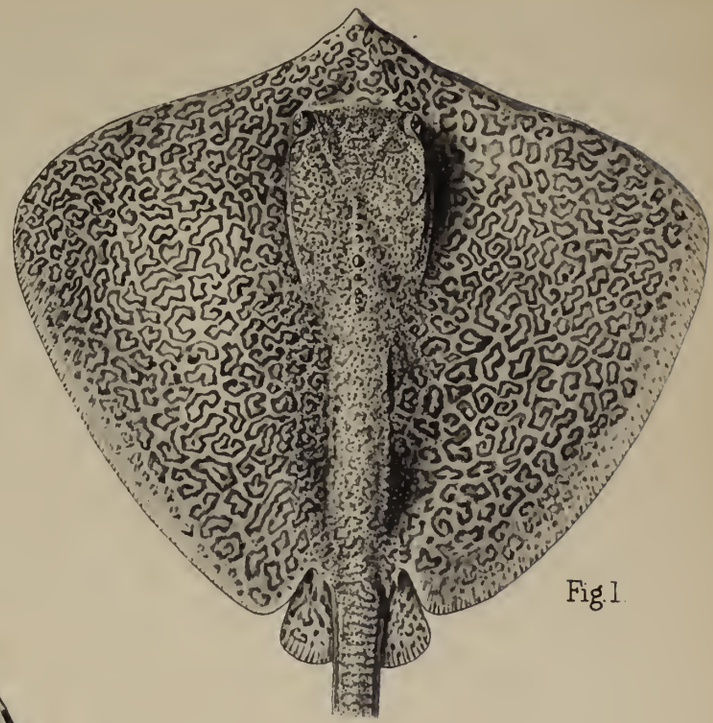


Fig. 1.

Fig. 2.

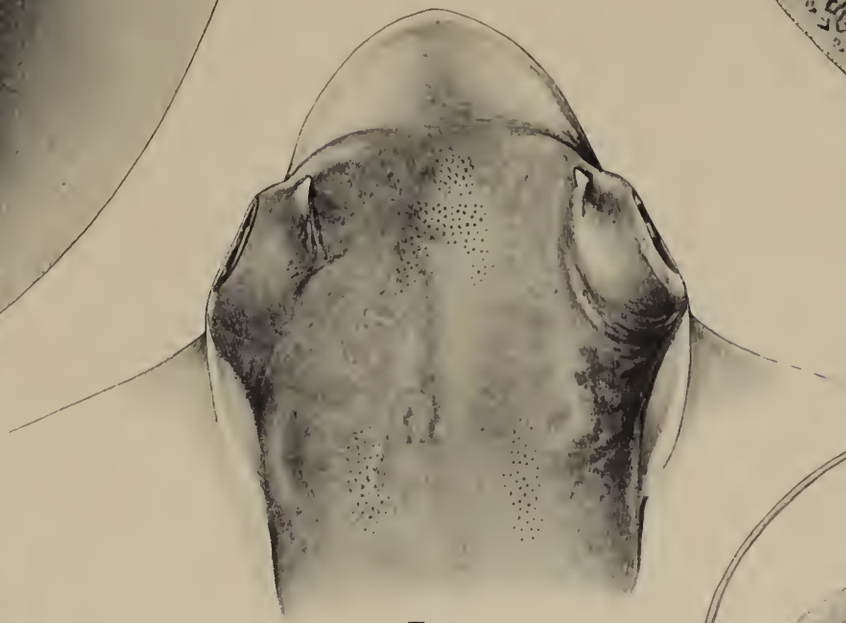


Fig. 4.

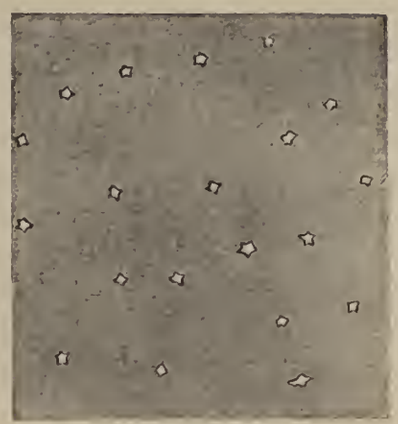


Fig. 4a.

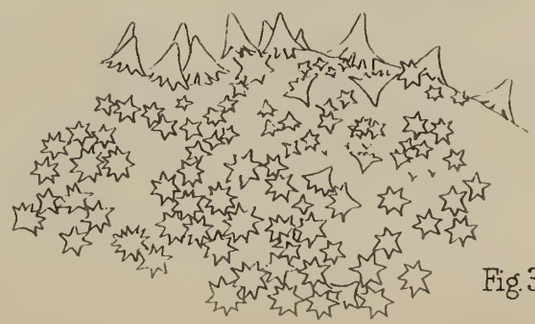


Fig. 3.

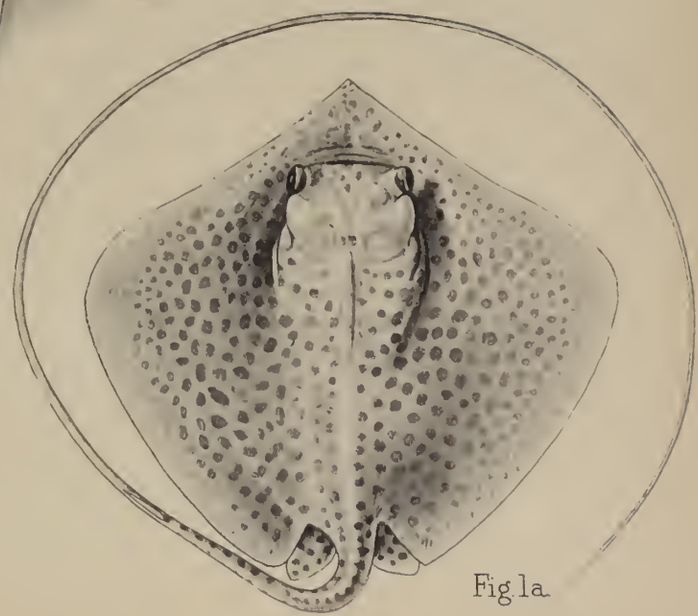


Fig. 1a.

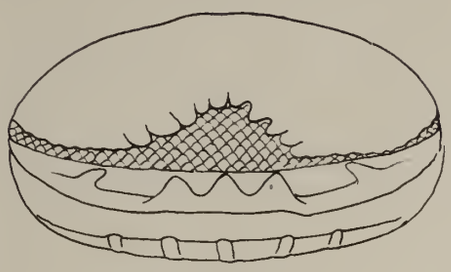
Drawn by A.C. Chowdhary

Bemrose Lt.d. Derby

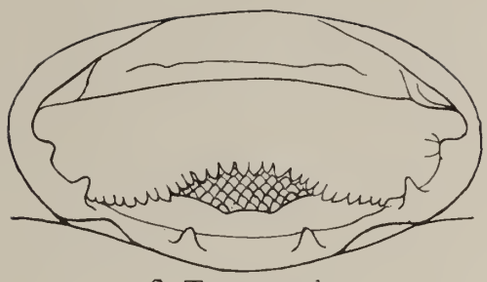
EXPLANATION OF PLATE III.

Mouths of Indian Trygonidæ.

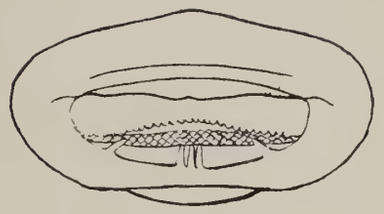
Fig. 1.—Internal view of mouth of *Trygon microps* (much reduced).
,, 2. ,, ,, ,, *T. uarnak* (much reduced).
,, 3. ,, ,, ,, *Hypolophus sephen* (much reduced).
,, 4. ,, ,, ,, *Trygon kuhlii*.
,, 5. ,, ,, ,, ,, *imbricata* or *walga*.
,, 6. ,, ,, ,, ,, *gerrardii*.
,, 7. ,, ,, ,, ,, *zugei*.
,, 8. ,, ,, ,, *Urogymnus asperrimus* (much reduced).
,, 9. ,, ,, ,, *Trygon bleekeri* (reduced).
,, 10. ,, ,, ,, ,, *favus* (much reduced).
,, 11. ,, ,, ,, ,, *marginatus* (much reduced).



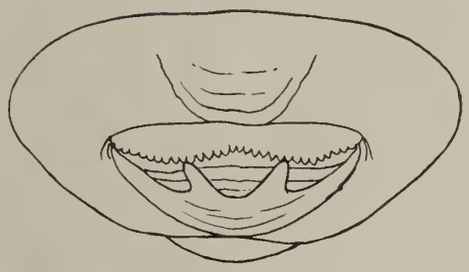
1. T microps.



2. T. uarnak.

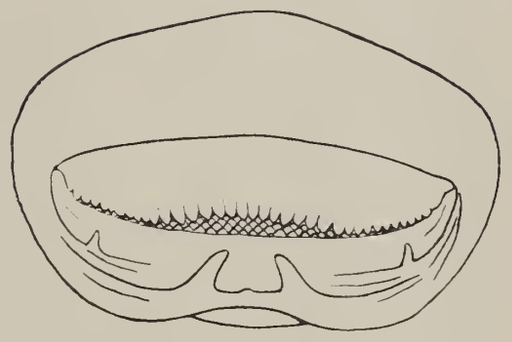


3. T sephen

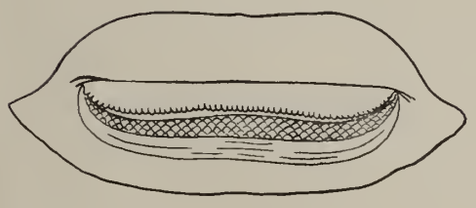


4 T. kuhlii.

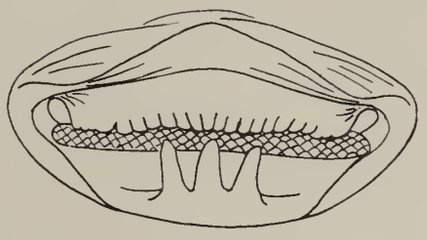
5 T. walga.



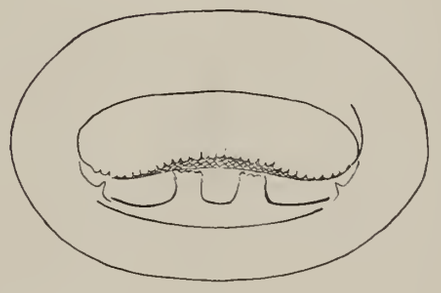
6 T. gerrardi.



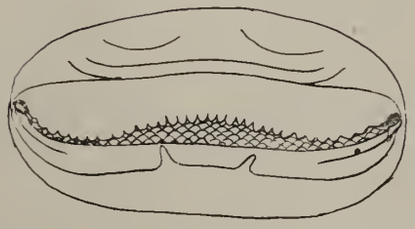
7. T zugei.



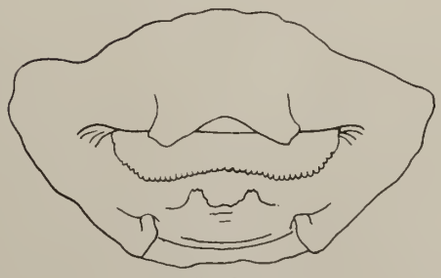
8. Urogymnus asperrimus.



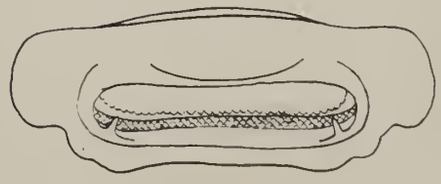
6*a*. T. gerrardi.



9. T. bleekeri



10. T favus.



11. T marginatus

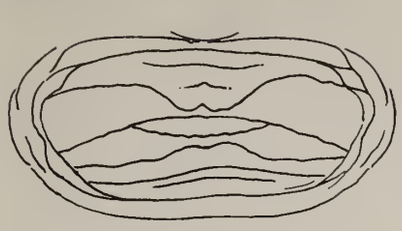
MOUTHS OF INDIAN TRYGONIDÆ.

EXPLANATION OF PLATE IIIA.

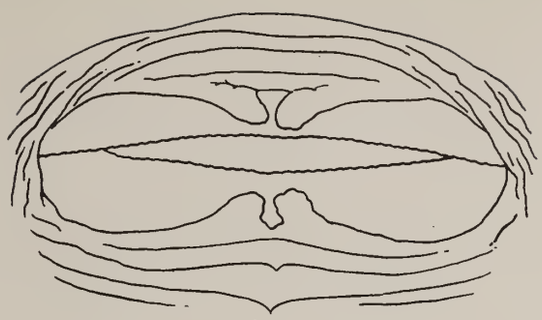
MOUTHS AND TEETH OF INDIAN TORPEDINIDÆ.

[*All the teeth are drawn from preparations mounted in canada balsam.*]

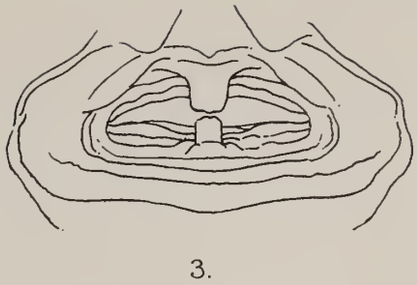
FIG. 1.—Internal view of the mouth of *Narcine timlei*, × 4.
,, 1*a*.—Teeth of the same, × 75.
,, 2.—Internal view of the mouth of *Narcine brunnea*, × 4.
,, 2*a*.—Teeth of the same, × 75.
,, 3.—Internal view of the mouth of *Narcine mollis*, × 6.
,, 3*a*.—Teeth of the same, × 75.
,, 4.—Teeth of *Torpedo marmorata*, × 20.
,, 5.—Mouth of *Benthobatis moresbyi*, × 8.
,, 5*a*.—Teeth of the same, × 75.
,, 6.—Mouth of *Astrape dipterygia*, × 6.
,, 6*a*.—Teeth of the same, × 75.
, 7.—Mouth of *Bengalichthys impennis*, × 6.
, 7*a*.—Teeth of the same, × 75.



2.

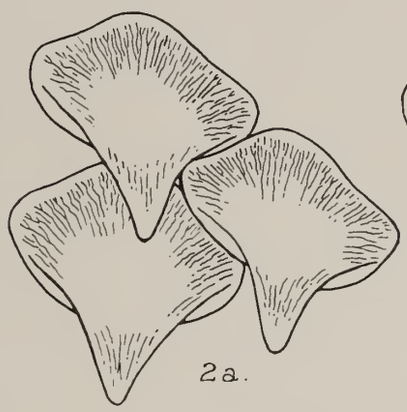


1.

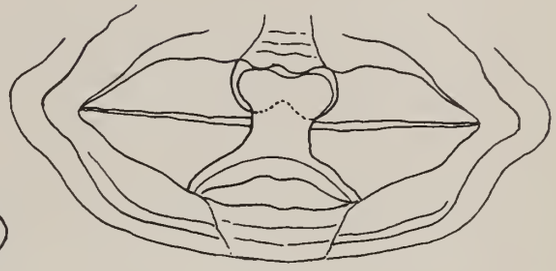


3.

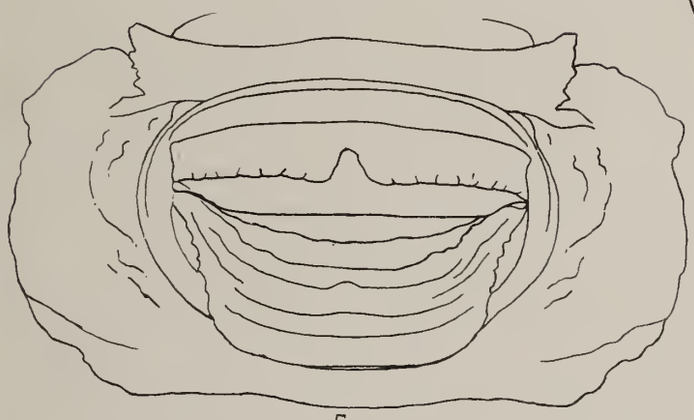
7.



2a.

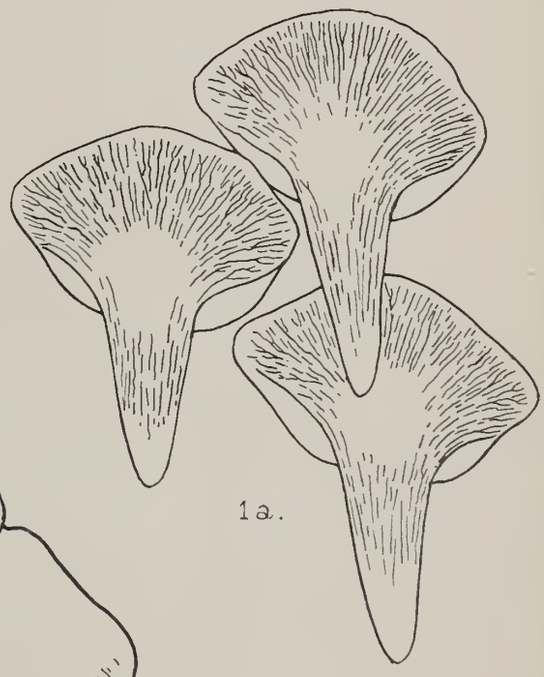


6.



5.

4.

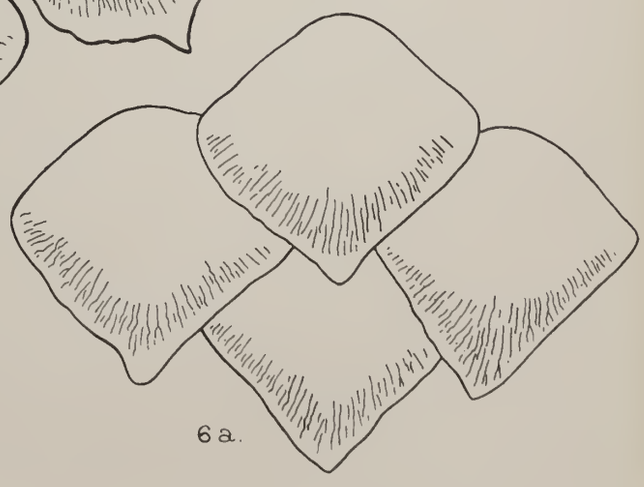


1a.

5a.

7a.

3a.



6a.

MOUTHS & TEETH OF INDIAN TORPEDINIDAE.

EXPLANATION OF PLATE IV.

FIG. 1.—Photograph of type specimen (♀) of *Trygon microps*. This specimen measured 6 ft. 6 in. across the disk.

,, 2.—Photograph of female specimen of *T. zugei*, × $\frac{3}{10}$.

,, 3.—Photograph of female specimen of *Pteroplatea zonura* (considerably reduced).

,, 4.—Photograph of young specimen of *Pt. tentaculata*, × *c.* $\frac{1}{2}$. A piece of white paper has been placed beneath the left tentacle.

,, 5.—Photograph of a male specimen of *Aëtobatis flagellum*, × *c.* $\frac{1}{5}$.

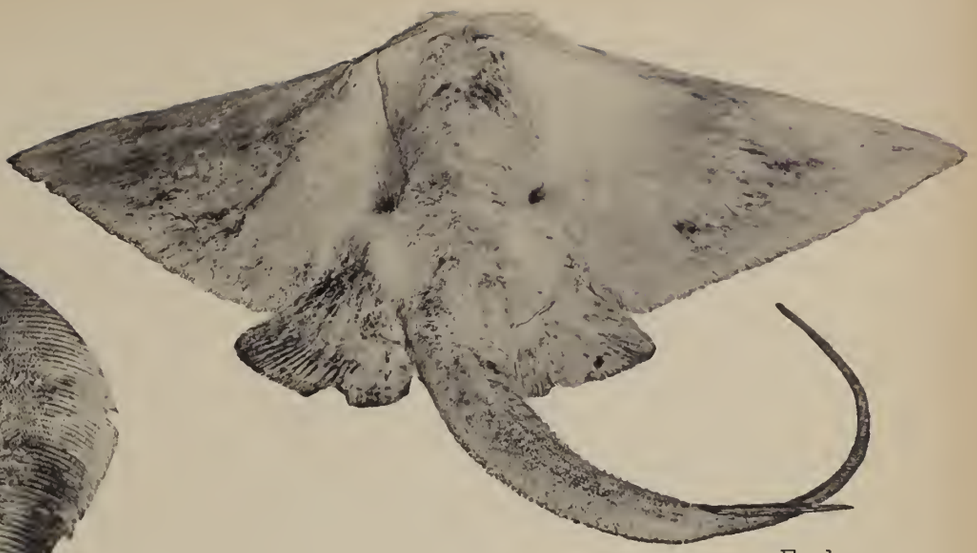


Fig 1.

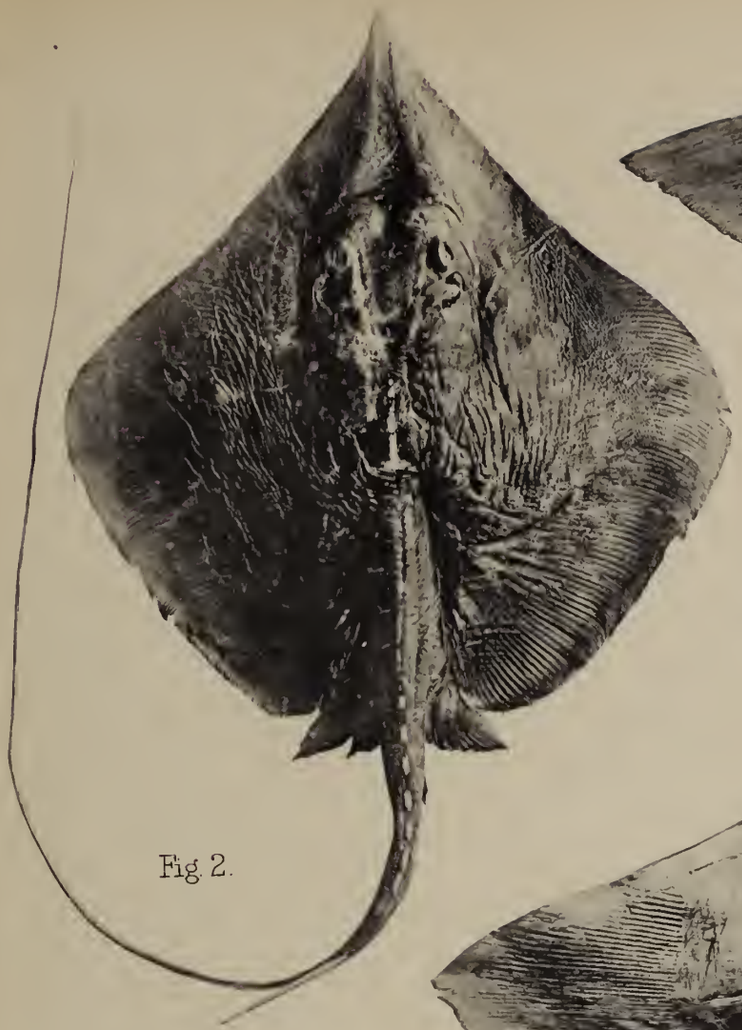


Fig. 2.

Fig. 3.

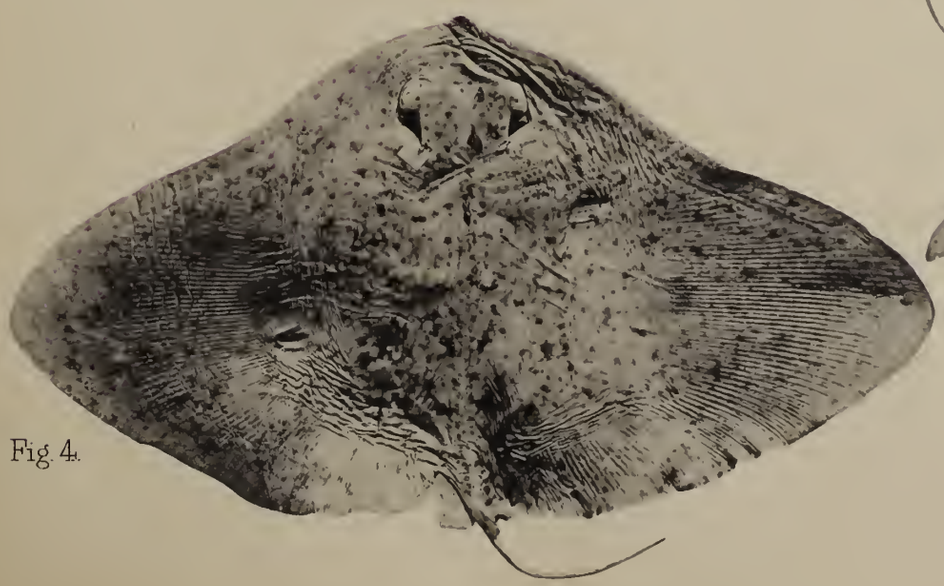


Fig. 4.

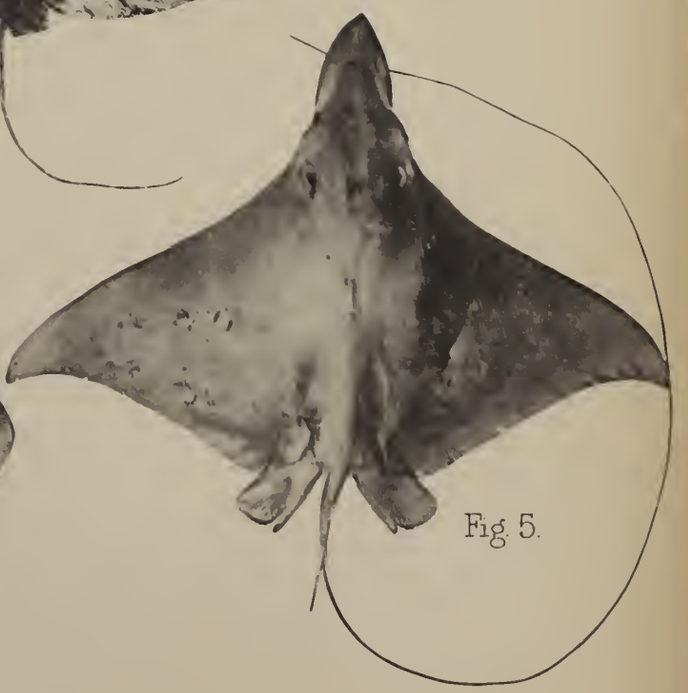


Fig. 5.

Photo by A.C. Chowdhary. Bemrose Ltd. Derby

EXPLANATION OF PLATE V.

FIG. 1.—Photograph of a male specimen of *Hypolophus sephen* in which the end of the tail has been lost (much reduced).

,, 2, 2*a*.—Photographs of a large female specimen of *Urogymnus asperrimus* in which the tail had been mutilated (much reduced). In fig. 2 the base of the disk is considerably foreshortened.

,, 3.—Photograph of a female specimen of *Torpedo marmorata* from the Orissa coast, × *c.* $\frac{2}{5}$.

,, 4.—Cast of the type specimen (♂) of *Pristis annandalei*, Chaudhuri, × $\frac{1}{14}$.

,, 5.—Photograph of a male specimen of *Rhamphobatis ancylostomus*, × *c.* $\frac{1}{15}$.

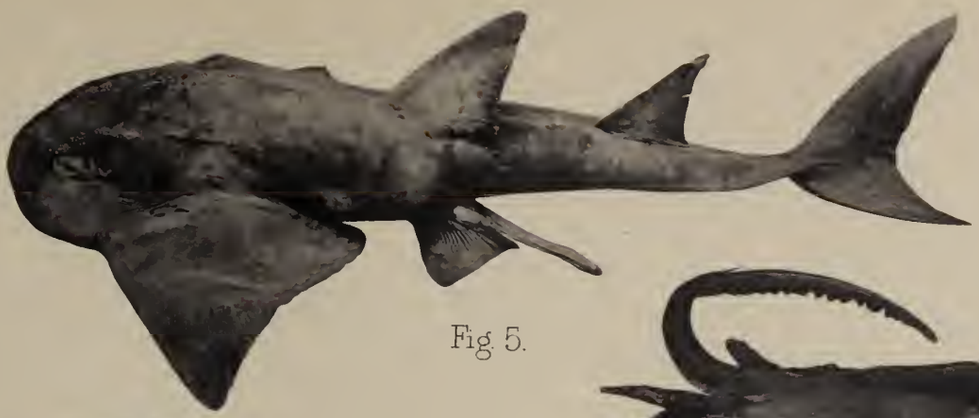


Fig. 5.

Fig 2a.

Fig 1

Fig. 4.

Fig. 3.

Fig 2.

Photo by A C. Chowdhary

Fig 1. Trygon sephen (tail abnormal). Fig 2, 2a. Urogymnus asperrimus. Fig 3. Torpedo marmorata.
Fig. 4. Pristis pectinatus var. annandalei. Fig 5. Rhamphobatis ancylostomus.

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AN ACCOUNT OF THE INDIAN CIRRIPEDIA PEDUNCULATA.

PART I.—FAMILY LEPADIDÆ (*sensu stricto*).

By N. ANNANDALE, *B.A., D.Sc., Superintendent, Indian Museum.*

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AN ACCOUNT OF THE INDIAN CIRRIPEDIA PEDUNCULATA.

By N. ANNANDALE, *B.A., D.Sc., Superintendent, Indian Museum.*

PREFACE.

The publication of Dr. P. P. C. Hoek's account of the Cirripedia Pedunculata collected in the Malay Archipelago by the "Siboga" Expedition,[1] and of several important papers dealing with the Pacific species by Dr. H. A. Pilsbry,[2] affords an occasion for revising the Indian collection in Calcutta. This collection is very nearly complete as regards specimens of the species as yet recorded from the seas of British India, but its chief importance lies in the fact that many of these species are represented by large numbers of individuals. A considerable proportion of the specimens has been collected by succeeding Surgeon-Naturalists on the R.I.M.S. ship "Investigator," but a large proportion has also been obtained from other sources. This is particularly the case as regards the family dealt with in this paper, many of its representatives being shallow-water forms. I am greatly indebted to Dr. P. N. van Kampen of the Dutch Fishery Board in Java, to Dr. W. T. Calman of the British Museum, to Dr. H. J. Hansen of Copenhagen, and to Prof. E. L. Bouvier of Paris for assistance in filling in gaps in the collection, while I owe the opportunity of investigating several of the semi-parasitic species largely to the specimens recently obtained by the Bengal Government's steam trawler "Golden Crown." The acquisition of new material from these sources has in many cases made it necessary to reconsider opinions I had previously expressed.

In the present contribution to the study of the Indian Cirripedes I propose to deal with those forms which may be conveniently referred to the family Lepadidæ in a restricted sense. The Pedunculata (that is to say, the Lepadidæ of older authors) have been variously subdivided, and it is perhaps impossible to discover a scheme for their classification that would satisfy all authorities. The fact seems to be that few groups afford so many or such perfect instances of convergence or adaptive resemblance. There is every justification for the belief that the primitive Cirripede was provided with a large number of calcareous plates or valves, and that from this ancestor evolution has taken place in several different directions both as regards the valves and as regards the internal anatomy of the animal and the various appendages

---

[1] "The Cirripedia of the Siboga Expedition," *Siboga-Expeditie*, A—Cirripedia Pedunculata, Monograph xxxi*a*, 1907 (Leyden).

[2] "Notes on some Pacific Cirripedes," *Proc. Acad. Nat. Sci. Philadelphia*, July, 1907, p. 360; "Notes on the Cirripede genus *Megalasma*," *ibid.*, September, 1907, p. 408; "Hawaiian Cirripedia," *Bull. Bureau of Fisheries*, vol. xxvi, p. 181 (1907); "The Barnacles (Cirripedia) contained in the collections of the U. S. Nat. Museum," *Bull. U. S. Nat. Museum*, No. 60 (1907).

and processes with which it is provided. No matter how the group is subdivided, however, it is necessary to include in each subdivision forms in which the valves have become degenerate in accordance with a semi-parasitic mode of life. In some cases it is only the dwarfed and otherwise degenerate males which exhibit this feature, while in others the large hermaphrodites do so. Moreover, it is necessary to recognize that even within the limits of a single family both divergence and convergence may take place in the course of evolution. It is clear, for instance, that the genera *Dichelaspis* and *Conchoderma* are not very closely allied to one another; yet evolution has taken a similar direction in each of them, and has produced similar results, which are to some extent correlated with a similar mode of life. It is the fact of convergence that makes it so difficult to subdivide the group, for it is often impossible to say whether a similarity in any one organ or structure is due to direct phylogenetic relationship or to parallel evolution, while the value that is to be given to each character is a matter that calls for the nicest discrimination—which, indeed, must always remain largely a matter of opinion.

In these circumstances it seems best to build the system of classification on as broad a basis as possible, and, after considerable hesitation, I have decided to adopt that put forward in Gruvel's *Monographie des Cirrhipèdes* (1905), with certain modifications rendered necessary by more recent investigations. Gruvel recognizes the following families and subfamilies :—

Family I.—POLYASPIDÆ.
  Subfamily (*a*).—POLLICIPINÆ (genera, *Pollicipes*, *Scalpellum*).
  Subfamily (*b*).—LITHOTRYNÆ (genus, *Lithotrya*).

Family II.—PENTASPIDÆ.
  Subfamily (*a*).—OXYNASPINÆ (genus, *Oxynaspis*).
  Subfamily (*b*).—LEPADINÆ (genera, *Lepas*, *Megalasma*, *Pœcilasma*, *Dichelaspis*, *Conchoderma*).

Family III.—TETRASPIDÆ (genus, *Ibla*).

Family IV.—ANASPIDÆ.
  Subfamily (*a*).—ALEPADINÆ (genus, *Alepas*).
  Subfamily (*b*).—ANELASMINÆ (genera, *Chætolepas*, *Gymnolepas*, *Anelasma*).

In criticising this arrangement the first point to be noted is that the names are not altogether satisfactory. It would have been both more convenient and more correct to call the families Pollicipedidæ, Lepadidæ, Iblidæ and Alepadidæ.

Apart from this, there are one or two features of the scheme that require alteration. Pilsbry [1] has recently pointed out that two very distinct genera have hitherto been confused under the name *Alepas*, and has proposed for all the species included under this name by Gruvel except the species first described (*Alepas parasitica*), the generic name *Heteralepas*. He has shown, further, that the genus *Gymnolepas* of C. W. Aurivillius is identical with Sander Rang's genus *Alepas*. This

[1] "The Barnacles (Cirripedia) contained in the collections of the U. S. Nat. Museum," *Bull. U. S. Nat. Mus.*, No. 60, p. 100 (1907).

being so, it is necessary to modify the arrangement of Gruvel's "Anaspidæ" pretty considerably. It is difficult, moreover, to separate *Heteralepas* very widely from *Conchoderma*, which, again, has indubitable affinities with *Lepas*. *Alepas* on the other hand, as restricted by Pilsbry, stands in some kind of relationship to *Chætolepas*, *Anelasma* and Hoek's new genus *Microlepas*. It is not altogether clear, however, how far this relationship is genetic, and as I have not seen any of these forms I cannot express a definite opinion. The four genera may be considered provisionally as forming a subfamily of the Lepadidæ.

There does not seem to be any very great gain in subdividing the "Polyaspidæ," the characters on which Gruvel bases the separation being clearly adaptive and connected with a difference of habits. I think it as well, however, to emphasize the close relationship between the genera *Pœcilasma*, *Megalasma* and *Dichelaspis* by regarding them as constituting a subfamily. For these reasons I propose to arrange the Pedunculata as follows:—

Suborder *PEDUNCULATA*.

Family I.—POLLICIPEDIDÆ.

Pedunculate Cirripedes in which the capitulum bears more than five valves with distinct centres of calcification. The peduncle clothed with well-defined scales or plates. Cirri long and curved; lateral appendages present or absent; anal appendages usually well developed, consisting of several joints. Parasitic males in one genus. Genera—*Pollicipes*, *Scalpellum*, *Lithotrya*.

Family II.—IBLIDÆ.

Pedunculate Cirripedes in which the capitulum bears four chitinous plates, which contain calcareous salts in older individuals. Peduncle not very clearly differentiated from the capitulum, bearing chitinous spines at any rate in young individuals. Cirri long and curved; lateral appendages absent; anal appendages with several joints. Parasitic males occur. Genus—*Ibla*.

Family III.—LEPADIDÆ.

Pedunculate Cirripedes with a well-defined capitulum, which typically bears five calcified plates. In many species, however, these plates tend to break up or even to disappear altogether. Cirri long and curved; lateral appendages present or absent; anal appendages, when present, with a single joint or with several or many joints. Parasitic males not produced.

Subfamily (*a*).—OXYNASPIDINÆ.

Small species with five well-developed valves. The valves bearing small calcareous points and covered by a membrane studded with chitinous spines. Lateral appendages absent; anal appendages very small or absent. Prosoma feebly developed. Genus—*Oxynaspis*.

Subfamily (*b*).—LEPADINÆ.

Species typically with five valves which occupy the greater part of the surface of the capitulum. These valves frequently much reduced or

altogether absent but never showing any tendency to split up in a secondary manner. When they are absent or degenerate the membrane of the capitulum is greatly thickened ; a muscular layer is sometimes present under the membrane. Lateral appendages normally present, only absent in a very few instances; anal appendages absent or consisting of a single claw-like joint, or multiarticulate. Mandibular teeth usually pectinate. Prosoma well developed. Genera—*Lepas*, *Conchoderma*, *Heteralepas*.

Subfamily (*c*).—Pœcilasmatinæ.

Species in which the five valves, unless they are degenerate, cover the whole of the capitulum. If degenerate they tend to split up in a secondary manner, the scutum being split into two by a vertical break in most species. The valves may be almost entirely absent, but the capitular membrane is not much thickened and is not lined by a muscular layer. Lateral appendages absent ; anal appendages with several joints. Mandibular teeth not regularly pectinate. Genera—*Pœcilasma*, *Dichelaspis*, *Megalasma*.

Subfamily (*d*).—Alepadinæ.

Degenerate pelagic forms with transparent membrane devoid of a muscular layer and with short, straight cirri. Valves absent or represented by the scutum only. Filamentous lateral appendages absent ; anal appendages absent or consisting of a single joint. Mouth parts much simplified. Genera—*Alepas* (*s. s.*), *Chætolepas*, *Microlepas*, *Anelasma*, (?) *Koleolepas*.

All the genera included in this table are described in Gruvel's " Monographie " except (1) *Heteralepas*, which has recently been established by Pilsbry (1907) for the reception of most of the forms previously referred to *Alepas* and of several new species, and (2) *Microlepas*, which has recently been discovered by Hoek (1907) in the " Siboga " collection.

PART I.—FAMILY LEPADIDÆ (*sensu stricto*).

INTRODUCTION.

There are few groups in which the subdivision into genera and species is more difficult than it is in the Pedunculata, and perhaps this is the case more particularly as regards the Lepadidæ than as regards the more primitive forms included in the Pollicipedidæ. I have already dwelt on the part played by convergence in the history of the group as a whole, and it is perhaps in the Lepadidæ that this phenomenon is most manifest. Convergence, moreover, is here accompanied definitely by a marked tendency to variation, which is strongest in those forms most degenerate as regards their external characters (see plate vi). The early ancestor of the Cirripedes must have been a free-swimming crustacean devoid of regular calcareous plates, which developed on the integument of its descendants after they adopted a sedentary life.

In the Lepadidæ, however, these plates (or valves, as they are called) have no sooner attained in the course of their evolution a definite number, form and relationship to one another, than their history takes another course and they commence to break up and disappear. I have already remarked that even within the limits of this family it is possible to distinguish different groups in which this degeneracy of the valves does not appear to be due to a common ancestry but rather to the influence of a similar environment on forms which stand to one another in the relationship of distant cousins rather than ancestors and descendants. The degeneracy is not, however, of exactly the same nature in all cases.

In one species of the genus *Lepas* (*L. tenuivalvata*) the valves have almost disappeared owing to their lack of calcification. Their shape, however, still remains the typical one; they show no tendency to split up, and they cover practically the whole of the capitulum.

In the genus *Dichelaspis* a nicely graduated scale of progressive degeneracy occurs. In the most primitive species (*e.g.*, *D. tridens* and *D. bathynomi*) the valves are still calcified and cover the greater part of the capitulum. The scutum, however, is split (as it is in several species of *Pœcilasma*) into two distinct segments, which diverge from one another slightly above, while the part of the same valve that is directed towards the carina has commenced to disappear to a degree differing in different individuals of the same species. Other species of the genus (*e.g.*, *D. warwickii*) still have a considerable part of their capitulum covered by the valves, but the two branches of the scutum are more divergent and the tergum is much reduced in size. In such species also the extent of the degeneracy is a variable character. Again, we find other species (*e.g.*, the typical form of *D. grayii*) in which the area covered by the five valves, which are still present, is relatively much smaller, and finally we arrive at forms in which some (or, in one case, all) of the valves have disappeared as calcified plates. In some specimens, however, of even the most degenerate forms it is generally possible to trace the outlines of the original five valves as raised lines on the integument, and often even the concentric lines on the calcified plate, representing the lines of growth, can still be traced on the soft tissues of the capitulum. This is the case as regards some individuals of *D. grayii* var. *pernuda*, in which there is no trace of calcification on any part of the capitulum.

Degeneration of the valves has taken a third course in *Conchoderma*, in which the membrane has become stout and the valves are very small (although never split up into secondary valves), altogether absent or devoid of calcium salts, while in *Heteralepas*, in which the thickening of the membrane is accompanied by a strong development of muscular tissue, the valves have practically disappeared, only the scutum persisting as a chitinous, ill-defined plate, and this only in some species. In neither of these genera is it ever possible to distinguish the outline of the original five valves on the capitulum.

These different types of external degeneracy are correlated with distinct differences in the structure of the appendages and therefore form a sound basis for the larger divisions of the family; it is worthy of note that they are not accompanied

(except to some extent in some species of the genus *Heteralepas*) by any degeneracy of the cirri and mouth parts such as characterizes the Alepadinæ.

The number and nature of the valves has formed the main consideration in all the systems of classification that have been worked out in detail as regards the Pedunculata, but the variation displayed by these structures is so great that it is often difficult to depend on them alone. Although, therefore, it is evident that even the appendages and mouth parts do not exhibit altogether constant generic and specific characters, they afford, considered together with the valves, most important information as regards the classification of the minor groups included in the Lepadidæ.

As regards the valves it may be noted that in some species (*e.g.*, in *Dichelaspis angulata* or *Conchoderma virgatum*) even the number of the primary valves is not constant, while their shape, relationship to one another and degree of calcification appear, if only a few specimens are examined, to provide sufficient justification for the subdivision of the species. When larger numbers of specimens are examined, however, it is seen that variation in any one character is not always or even usually correlated with variation in any other, so that, unless an indefinite number of species, based on various combinations and permutations of characters, is to be recognized, many forms which at first appeared distinct must be grouped together under one specific name.

The exact proportions of the various appendages, the arrangement of the hairs on each and the exact outline of those connected with the mouth have been regarded by some authors as characters so constant that they may, in the opinion of these authors, be considered as practically devoid of variation. In many species, however, the examination of a large number of specimens shows that not only (in the individuals examined) do these characters differ from published descriptions and figures, but also that they vary in different individuals captured in the same place and in identical conditions, although the limits of variation are sometimes narrower in their case than in that of the valves. For example, in three specimens of *Pœcilasma minutum* from the same specimen of *Panulirus* chosen at random and dissected consecutively, the anal appendages failed to reach the tip of the basal joint of the sixth cirri in one, greatly surpassed this point in the second, and just reached it in the third. In the genera *Dichelaspis* and *Pœcilasma*, moreover, the number of teeth is not always the same on the two mandibles of the same individual.

Such difficulties arise not only as regards species but also as regards genera. Darwin was abundantly justified in separating the species he grouped in the genus *Dichelaspis* from those he grouped in the genus *Pœcilasma*, although he recognized that the main, if not the only, difference between the two genera consisted in the degeneracy of the valves in *Dichelaspis*. Since his time, however, several species have been discovered which link the two genera together in such a way that any separation between them must be regarded as a purely artificial one, maintained for the sake of convenience and not on morphological grounds.

It is often convenient to recognize genera erected on a purely artificial basis, because it becomes extremely difficult to deal with long lists of species grouped under one generic name ; but it should be clearly understood that the division in such cases

is artificial. The question need not arise as regards genera containing a small number of species, for in such cases it is clear that the multiplication of divisions is unnecessary and apt to confuse rather than elucidate. In the case of species, however, I am in favour of only recognizing those which are clearly different from one another and separated by a distinct gap in the line of variation. Narrow gaps as regards structure, which cannot be bridged over completely, exist between the offspring of a single parent or pair of parents, as we see in the larger animals, in which they are easily detected; and narrow gaps, a little wider in many cases, are clearly visible between the children of different parents. It is impossible to take notice of all such gaps, many of them being incapable of detection by the senses and rather inferred than proved to exist, while others, which can be detected, are so inconstant, and obey any known law so little, that to recognize them causes confusion and does not assist in a rational system of classification. There are other narrow gaps which can not only be detected but also proved to separate large groups of individuals to some slight extent. They are still so narrow, however, that they can only be detected by the closest study (or even by a comparison of specimens), and are not sufficiently marked to be used as arguments in proving any divergence in genetic relationship between the groups they separate.

Groups thus separated are peculiarly common in the Cirripedes and occur in many species of Lepadidæ. To regard them as distinct species would militate against any investigation of the geographical distribution of the group, and would only complicate its study from a morphological point of view. It must be clearly understood, moreover, that the gap which separates them is not of the same nature in all cases, or due to the same causes; and therefore it is inadvisable to call all of them either "varieties," "subspecies," or "races," or to designate them in any other way that fails to mark their divergence in character.

Apart from developmental phases, which have been little studied in the Lepadidæ and are not always easy to distinguish, we find that the smaller groups into which the species may be divided are mainly of two kinds. In the first place it is easy to prove that certain species are peculiarly liable to give rise to local races, the individuals of which are more or less constant among themselves and differ from individuals from any other locality. Such groups I have called races or subspecies. Another kind of group, however, occurs not infrequently, consisting of a number of individuals not separated by any geographical boundary from others of the same species but differing from the typical form (*i.e.*, the form first described) in unimportant characters, which may or may not be hereditary. Such groups I have called "varieties." In most cases there is nothing definite to prove whether the varieties of a species do or do not interbreed, but the probabilities are in favour of the former mode of propagation.

The best example of a species with different races that I know among the Lepadidæ is *Pœcilasma kæmpferi*, which occurs in its typical form in Japan and the S. Pacific but is represented by subspecies in several different parts of the Indian and Atlantic Oceans. True varieties are less common among the Lepadidæ than they are

among some other families of Cirripedes (for instance, in the genus *Balanus* in the Balanidæ) and I cannot find a very good example among the Indian species of the Lepadidæ, for in cases in which variation is most common and most extreme it is very difficult (and therefore inadvisable) to subdivide species at all, one of the first requisites of a sound classification being that it should be free from unnecessary complexities. The best example of a variety among the species described in this paper is the var. *fissicarina* of *Dichelaspis geryonophila*. This form has the carina split transversely, while the valve is entire in the typical form of the species, which occurs side by side with *fissicarina* on the same crab.

Distinct as the two kinds of groups into which species may be subdivided really are as regards origin, it is not always easy to say whether a group should be regarded as representing a variety or a race. The only way to settle such a question is to examine a very large number of specimens from different localities and districts that have been recorded accurately. Few museums possess collections of sufficient scope to render this possible, and even in cases in which it has been possible to examine series including hundreds of specimens from one or several localities, such series rarely represent more than one region or district. A case in which a difficulty of the kind arises is that of the forms assumed by *Conchoderma virgatum*. To some extent these several forms appear to have a geographical significance, but individuals intermediate between them occur in the same localities as other individuals that agree exactly with local types, and in any case the number of specimens examined by any one specialist has been comparatively small. There are doubtless European and American museums in whose collections fairly large European and American series of the species are included, while the Indian Museum contains a very fair series of Indo-Malayan specimens; but it has not been possible to make arrangements to compare all the specimens already preserved in collections, much less to collect sufficient material from widely separated stations for a proper study of the species as a whole.

In preparing this paper, therefore, I have thought it best to restrict my attention so far as possible to species occurring in the Bay of Bengal (including the Andaman Sea and the Gulf of Manaar) and the Arabian Sea, as parts of which the Laccadive Sea to the south and the Persian Gulf to the north may be conveniently regarded. Until recently the two subfamilies Alepadinæ and Oxynaspidinæ were not known from within these limits, but during the last few weeks a species of *Oxynaspis* has been found at the head of the Bay of Bengal in considerable numbers, and there can be little doubt that representatives of the Alepadinæ will also be discovered at some future date. In the meanwhile, however, I cannot, through want of material, deal with this subfamily.

The greater number of the Indian species of Lepadidæ have already been well figured, either in the *Illustrations of the Zoology of the R.I.M.S. "Investigator"* or elsewhere. I have therefore been forced to economize as regards illustrations and to do without detailed figures. I am much indebted, however, to the draftsmen of the Indian Museum and the Indian Marine Survey for assistance in preparing the outline figures here reproduced.

SYSTEMATIC ACCOUNT OF THE INDIAN SPECIES.

Subfamily *OXYNASPIDINÆ.*

Genus OXYNASPIS, Darwin (1851).

Lepadidæ with five calcified valves, which are covered (as well as the peduncle) by a membrane bearing horny spines. The valves themselves bear minute calcareous projections corresponding to the spines. The umbo of the scutum is on the occludent margin. Mandibular teeth sometimes pectinated; edge of maxilla with an excavation but not regularly scalariform. No lateral appendages; anal appendages (if present) short, bearing a terminal bunch of hairs, by no means claw-shaped. Prosoma feebly developed or absent.

Darwin was of the opinion that the spiny membrane which covers the whole surface in this genus, did not belong to the barnacle but to the horny coralline to which it was attached. Other writers have followed him in this view, which, despite the great weight of his authority, I am forced to consider incorrect after an examination of a considerable number of specimens of an Indian form. Some of these were fresh, others dry, and others preserved in spirit and formalin. The Antipatharian to which they were attached bore no spines on its surface similar to those which covered the barnacle, and the spines corresponded exactly with the calcareous projections on the valves. Moreover, the Antipatharians were of a neutral blackish tint, while the membrane was purplish red. In my specimens the whole of the membrane was extremely thin, and there were no signs of the surface being covered by a "horny muricated bark"—a description, indeed, hardly applicable to any part of the particular species of Antipatharian to which the specimens were fastened.

Hitherto the genus *Oxynaspis* has been known from the Atlantic and Pacific. The discovery, therefore, of a species in shallow water in the Bay of Bengal is particularly interesting. It must be remembered, however, that the Atlantic species are very rare and that others will probably be found in intermediate localities.

Oxynaspis celata, Darwin, subsp. *indica*, nov.

CAPITULUM laterally compressed, sharply pointed and slightly retroverted at the apex, about half as broad as long. The inner membrane deep brownish purple; the body of the animal and the pedicels of the cirri covered with pigment spots of the same shade; the rami of the cirri, except at the extreme base, milky white. Valves thick, deeply tinged with orange-red; the spines on the membrane covering them of the same colour but darker; the surface of the valves ornamented with strong ridges radiating from the umbo and also with numerous minute rounded prominences corresponding to the spines on the membrane; the distal ends of the ridges produced so as to form well-marked rounded projections on the edges of the valves. *Tergum* triangular, the apical and carinal angles acute, the occludent angle greater than a right angle; the extreme length of the valve about twice that of its occludent margin; the

occludent margin considerably thickened; the carinal margin straight or slightly convex; the scutal margin almost straight. *Scutum* subtriangular, its lower part inflated; the occludent margin more or less convex; the carinal margin straight or convex backwards, the basal margin almost straight; the umbo nearer the base of the occludent margin of the valve than the apical angle, which is more or less produced; a prominent ridge, which runs down the occludent margin, and a deep impression for the adductor muscle, present on the inner surface of the valve. *Carina* very broad, elbowed, the basal branch about half as long as the vertical one; the external surface tuberculate, the internal surface smooth, with a deep vertical groove; the base expanded into a small transversely oval or subquadrangular, flat disk.

Peduncle short, cylindrical, irregularly annulated, very hard and stiff, covered with chitinous spines.

Cirri, etc.—All the cirri long and curved, the rami of the second pair subequal, about three times as long as the pedicel. First pair not widely separated from the second; rami slender, subequal, with about 11 joints; the anterior face of each joint covered with transverse rows of bristles with distinct circular sockets; the distal joint ending in two very long bristles with several shorter hairs. *Anal appendages* reduced to mere minute prominences bearing five or six long, delicate hairs. *Penis* long, slender, pointed, bearing scattered hairs; the distal half annulated and ridged longitudinally; the whole organ densely pigmented except for a comparatively large area near the base.

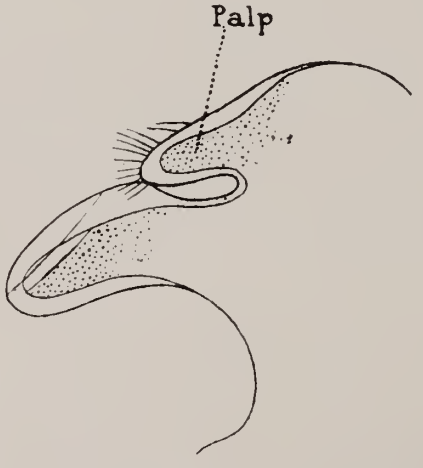

Fig. 1.—Labrum of *O. celata* sub-sp. *indica*, viewed from the left side.

Mouth parts.—*Labrum* produced into an oval, concave, somewhat spatulate plate, which is relatively broad when seen from above but appears cylindrical and horn-like when viewed from the side; it is almost twice the length of the palpi. Pa'pi stout, bluntly pointed, bearing a fringe of rather long, delicate hairs at their tip. *Outer maxilla* broadly oval, subtruncate, bearing an irregular fringe of hairs of different lengths which is best developed on the anterior border. *Maxilla* narrow; its cutting edge with an excavation near the outer margin and with the inner part very prominent; external to the excavation one large bristle and on either side of it (*i.e.*, on either face

of the maxilla) one rather smaller bristle; the bristles internal to the excavation not very long, of different sizes. *Mandible* with five teeth (including the inner angle); the first tooth separated from the second by a space at least as great as that which separates the second from the internal margin of the maxilla; second, third, fourth and fifth teeth subequal; the fifth directed outwards from the inner margin; the base of the second distinctly but minutely pectinated on the outer margin; the third similarly but less distinctly ornamented.

Large specimens measure 9-10 mm. in length of capitulum.

HABITAT.—Off Akyab, Northern Burma: on Antipatharians growing in about 17 fathoms (S.S. "Golden Crown," January 1909); off Orissa, Bengal: on Antipatharians growing in 20 fathoms (S.S. "Golden Crown," February 1909).

This form agrees in so many respects with Darwin's *Oxynaspis celata*[1] from Madeira that I cannot regard it as a distinct species. There are certain differences, however, which seem to justify its being considered a local race. I have therefore called it "subspecies *indica*." The chief points of difference between it and the typical form are, judging from Darwin's description and figures:—(1) the basal arm of the carina is much shorter than the vertical arm; (2) the concavity of the inner surface of the carina is greater; (3) the margins of the scutum and tergum are more strongly serrated; (4) the two rami of the second pair of cirri are subequal; (5) all the cirri are curved. It must be remembered, however, that Darwin says that all the specimens he examined were in a bad state of preservation, and that, therefore, it is possible that his descriptions of the soft parts would have differed in detail had he examined fresh specimens.

Subfamily *LEPADINÆ.*

Key to the Genera.

1. Valves covering practically the whole of the capitulum.
   (*a*) Lateral appendages not more than 6 .. .. *Lepas.*
2. Valves reduced in size or absent, capitular membrane swollen.
   (*a*) Lateral appendages numbering 12 or 14; no anal appendages; at least three valves distinguishable .. *Conchoderma.*

[1] Dr. W. T. Calman of the British Museum has been kind enough to examine some specimens of the Indian form and to send me the following note:—"The types of *Oxynaspis celata*, or what I take to be the types—they are from Madeira and labelled in Darwin's writing—are dried and include several separated valves stuck on a card. I have cleaned the valves of one of your specimens to compare with them. There are certain differences which may indicate that the species are distinct, although, without a larger series and more careful study, I should hesitate to state that this is so. The most obvious differences are that the scutum is more acutely produced above and the carina much wider and more deeply cupped than in the Indian specimen. Also the margins of the valves are less strongly toothed than in your specimen. Darwin's figures of the separated valves give a very accurate impression of the type specimens and show the differences I have mentioned from yours."—*March 3rd*, 1909.

(*b*) Lateral appendages numbering 2; anal appendages multi-articulate; not more than one pair of valves .. *Heteralepas*.

Genus Lepas, Linné (1767).

The inclusion in the genus of *Lepas tenuivalvata* renders it necessary to modify the description of the genus a little, but I have no doubt as to the propriety of adopting this course. The possession by the species in question of filamentous appendages, the structure of its anal appendages, mandibles and maxillæ and the form of its valves, so far as this is perceptible, ally it indubitably to *Lepas* if considered together, while the curious modification in structure exhibited by its shell is clearly an adaptation to a mode of life somewhat unusual in the genus. It may be convenient, however, to regard it as the type of a new subgenus, for which I propose the name *Hyalolepas*. I am of the opinion, with Pilsbry and other writers on the Cirripedia, that *Lepas fascicularis*, Ellis and Solander, should also be considered as representing a subgenus distinct from that of the typical *Lepas*; Gray's name *Dosima* may be used for the former while the latter may be called *Anatifa*, Brugière, for it is desirable to avoid the duplication of names as regards subgenera when possible.

The genus and its subgenera may therefore be diagnosed as follows:—

Genus Lepas, Linné (1767).

Lepadidæ with five valves, which are usually well calcified and more or less approximate; the carina extending between the terga above, terminating below in an embedded fork or an external disk; scuta triangular or subtriangular, with their umbones at the rostral angle. Lateral appendages usually present; anal appendages consisting of a single joint, uncinate; without long hairs. Mandibles with five or six teeth; maxillæ with the free edge scalariform. Peduncle usually well developed, naked, or provided with chitinous plates.

Subgenus *Anatifa*, Brugière (1789).

Valves fully calcified, usually opaque; base of the carina forked, the branches of the fork being short or widely extended.

Subgenus *Dosima*, Gray (1825).

Valves fully calcified but translucent; base of the carina expanded into an external disk.

Subgenus *Hyalolepas*, nov.

Valves barely calcified; the umbones indistinct; carina forked at the base, the branches of the fork, so far as they are distinguishable, being long and almost parallel to one another.

Subgenus Anatifa, Brugière.

Seven species of this subgenus have been described, of which five are common and widely distributed, while two are rare or possibly have a restricted geographical

range. So far as is known, only two species occur in Indian seas, but it is probable that at least three others are brought in as occasional and adventitious immigrants on the bottoms of ships.

No specimens in the collection have given me so much trouble as the representatives of *Anatifa*, partly because they are, for the most part, so well known that few authorities have given a detailed account of the specimens they have examined, partly because the specific differences between three of the common species appear to break down to a considerable extent so far as Oriental specimens are concerned. These three species are *Lepas anatifera*, *L. anserifera* and *L. pectinata*. Judging from Darwin's descriptions, from Hoek's figures in the "Challenger" Reports, and from the few European specimens I have examined, I have no reason to doubt that they are specifically distinct from one another. Unfortunately, however, Darwin had few Indian specimens before him while preparing his incomparable monograph on the Cirripedia, and the definitions he gives are not always applicable in all respects to such specimens. I have not been alone in my difficulties as regards Oriental specimens of the common Indian species (*L. anserifera*), for Hoek, in his recent account of the Pedunculate Cirripedes of the "Siboga" Expedition (1907), writes as follows:—

> "The specimens [of *L. anserifera*] collected in the Bay of Labuan Tring (Lombok) caused me some difficulty as they differed from the usual appearance of *L. anserifera* in one of its most distinctive characters, *viz.*, in the occludent margin of the scutum not being arched or protuberant. Further, the internal umbonal tooth of the right-hand scutum is hardly stronger than that of the left-hand scutum. But as these characters vary even within the specimens of this locality, the form of the scutum in some of them approaching more to the typical form than is the case in others; there existing, moreover, a close resemblance in other regards between this and the typical form, no doubt was left as to the importance of this difference." (*Siboga-Exped.*, Mon. xxxi*a*, Cirr. Ped., p. 2.)

Some of the Indian specimens I have examined (*e.g.*, those from Akyab) are typical examples of *L. anserifera*; others evidently agree with Hoek's specimens from Lombok. I also find, however, that in some specimens in which the scutum resembles that of *L. anserifera*, or that of *L. pectinata*, or has an intermediate character, the valves are nearly smooth. This is particularly noticeable in some of Professor Herdman's specimens from Ceylon, which I referred to *L. anatifera*, I still think rightly. Further, there is a considerable variation in the angle formed by the fork of the carina. In some specimens, moreover, which I assign to *L. anserifera* the upper extremity of the peduncle is clearly of an orange colour or (in specimens long preserved in bad spirit) at any rate paler than the lower part; but in others the dark coloration extends to the base of the peduncle, although the capitular membrane is always pale. Lastly, even the filamentous appendages exhibit a certain amount of variation in specimens agreeing in other characters. The upper pair of these appendages at the base of the first cirrus, as Darwin noticed, is frequently rudimentary in small individuals; in some of

my specimens not only these appendages but also the pair adjacent to them are short, consisting merely of short, rounded prominences, so that only one pair (that on the prosoma on each side) is fully developed. This pair, however, is always long and pointed. Darwin describes *L. pectinata* as having not more than one appendage on each side, but Gruvel says, " Appendices filamenteux, absent, ou seulement une paire de chaque côte." Probably Darwin is right; but it is safe to say, in any case, that the appendages of *L. pectinata* are never so well developed as those of at least one pair on each side in *L. anserifera*. The mouth parts of the former species are highly variable, and therefore no help may be expected so far as they are concerned in separating this species from *L. anserifera*.

Fig. 2.—Lateral appendages of *Lepas anserifera*, × 8, right side.

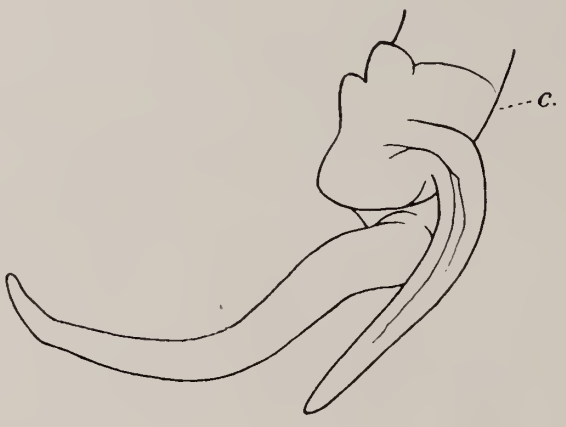

Fig. 3.—Lateral appendages of *Lepas anatifera* subsp. *indica*, × 8, right side.

On the whole, in spite of the close resemblance between some Oriental specimens of *L. anserifera* and the typical *L. pectinata*, I am convinced that all the Indian specimens I have seen belong either to *L. anserifera* or *L. anatifera*. Most of them agree with the descriptions of the variety called *Pentalasmis dilata* by Leach, which Darwin was at first inclined to regard as a distinct species; but individuals intermediate between this and the typical form of *L. anserifera* occur not infrequently.

Since the bulk of this paper was written I have had an opportunity of examining large numbers of living specimens of the subgenus *Anatifa* on the Orissa coast. Two forms occurred in abundance, in one instance side by side on the same log of wood. The exact status of the Oriental race of *L. anserifera* seems to be more doubtful than ever. Possibly it is the ancestral form from which the *L. anserifera* of temperate climates and also *L. pectinata* have branched off in different directions. It is difficult, however, to call it by a special name as it includes many individuals, perhaps, indeed, a great majority, which it would be impossible to distinguish from

European or North American examples. I may also note that in European specimens of *L. pectinata* sent me by Professor Bouvier and identified as such by M. Gruvel I find considerable variation as regards the distance of the vertical ridge on the scutum from the occludent margin.

In any case it will be as well to give detailed descriptions of the two forms which occur together in the Bay of Bengal, basing these descriptions on an examination of fresh material, in which the characters are naturally better seen than in material that has been long in spirit. I see no reason to doubt that these two forms represent, respectively, the *L. anserifera* and *L. anatifera* of Linné; but those that represent the latter do not belong to the typical form of the species.

Lepas anserifera, Linné.

CAPITULUM broadly triangular, compressed; occludent margin sinuous, carinal margin curved. Valves thick, opaque, white, with strong radiating ridges and lines of growth, occupying the whole of the capitulum, covered by a delicate yellowish membrane, which is very liable to be rubbed off. *Tergum* almost quadrilateral, the apex being more or less definitely truncate; the occludent margin straight, slanting outwards; the scutal margin about three times as long as the occludent, without a strong tooth at the occludent angle. *Scutum* large, subtriangular, somewhat convex (especially at the base); nearly as broad at the base as long; the occludent margin boldly arched, forming the outer limit of a narrow (more or less), spindle-shaped area, of which the inner limit is formed by a bold vertical ridge on the valve; each scutum with an internal umbonal tooth, but the tooth on the right scutum always stouter than that on the left. *Carina* broad laterally, tapering above to a point, deeply concave within; produced below the base of the scutum and forming a prominent inwardly directed tooth, bearing two vertical branches, which meet one another at an angle greater than a right angle (or rather, would do so were not the angle rounded off); the dorsum plain or pectinated.

PEDUNCLE usually shorter than the capitulum, never much longer, cylindrical, without vertical ridges, variable in colour, being wholly deep orange in some individuals, wholly dark purple in others, mostly purple but orange at the capitular end in some.

The lining membrane of the capitulum dark purple, usually becoming orange at the edges of the aperture, so that the occludent margins of the terga and scuta appear of the latter colour. Body of the animal white, more or less deeply tinged with purple, with a dark purple streak along the dorsal surface. All the cirri dark purplish brown. The oral appendages covered with purple pigment cells. On the mandibles these form a conspicuous scalariform line parallel to the edge but at some distance from it. As a rule one of the lateral appendages on the prosoma is purple, while the others are white. The anal appendages are purplish brown.

CIRRI, etc.—The cirri are moderately long, not so boldly curved as in some species. Each joint bearing in front a broad band of soft hairs and a small bunch of short, stiff hairs at the apex behind. The two rami of the first cirri are unequal, the posterior

ramus reaching the base of the fourth joint from the tip of the anterior ramus; both rami are pointed and tapering, with the last few joints very small, the anterior ramus having about 16 and the posterior ramus about 14 joints, but those at the base being imperfectly differentiated in each case and variable in this respect. The anterior ramus of the second cirrus is slightly longer than the posterior but each has about 30 joints. The first cirrus is not very widely separated from the second. There are four lateral appendages on each prosoma, two being very much longer than the others (which are sometimes almost rudimentary), and two at the base of each first cirrus, one of them on each side being very long and delicate. The *penis* is not so long as the sixth cirrus; it is slender, tapering to a point, minutely annulated, densely covered with soft hairs of irregular length, especially on the distal half; there is a pencil of rather longer hairs at the tip. *Anal appendages* smooth, short, distinctly curved and claw-like.

Mouth parts.—*Labrum* moderately prominent. *Maxilla* with a deep excavation near the upper margin, from which it is separated by several long stout spines, one of which is particularly well developed. Below the excavation are three steps of somewhat variable proportions, each bearing a double row of stout bristles. *Mandible* with six teeth including the inner angle, which is pointed but rather stout and bears a dense fringe of short bristles on both edges.

Lepas anatifera, Linné, subsp. *indica*, nov.

Capitulum compressed, subtriangular, the apex being somewhat truncate; the carinal margin arched, the occludent margin slightly sinuous. The valves thick, opaque, white, covered with a delicate, deep purple membrane arranged in sinuous parallel bars corresponding with the lines of growth. This membrane is easily rubbed off and soon loses its colour in spirit. When worn it often persists as a line of square spots in a series of small depressions running down the capitulum from near the umbo of the tergum to that of the scutum in a curved line and growing larger in the middle of the line than they are at the ends. The valves are separated from one another by lines of purple or purplish membrane, which are sometimes rather broad towards the base of the scutum. *Tergum* broadly truncate at the apex; the occludent margin straight, slanting outwards, produced into a tooth at its junction with the scutal margin; about one-fourth as long as the scutal margin; radiating ridges prominent, especially one running from the umbo to the occludent angle. *Scutum* quadrilateral (the scutal margin being distinct from the carinal margin), feebly convex even at the base; the surface almost smooth except for a vertical ridge, which bears the same relation to the occludent margin as the homologous ridge does in

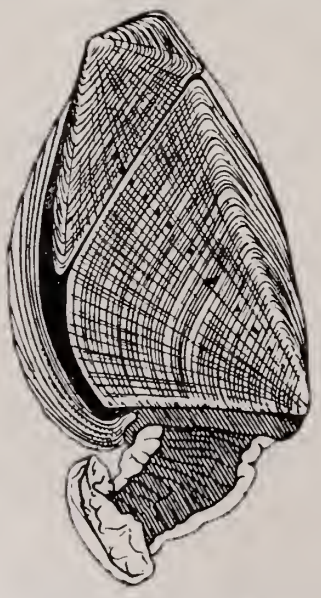

Fig. 4.—*Lepas anatifera* sub-sp. *indica*, × 2½.

L. anserifera; not so broad at the base as long; internal umbonal tooth on the left scutum only; a prominent external basal ridge on both. *Carina* usually pectinate dorsally, otherwise as in *L. anserifera*.

PEDUNCLE shorter than capitulum, somewhat compressed, bearing a distinct pale vertical ridge on the occludent surface and two similar parallel ridges on the dorsal surface, variable in colour, generally deep purple slightly paler both at the base and the apex.

Lining membrane of the capitulum deep purple, not changing to orange on the sides of the aperture. Body lilac-purple; first, fifth and sixth cirri dark purple, the two latter brownish at the base; other cirri yellowish, with the anterior and posterior surfaces purple; anal appendages brown; mouth parts coloured as in *L. anserifera*; lateral appendages white.

CIRRI, etc.—Cirri much as in *L. anserifera*. *Penis* likewise. *Lateral appendages* only two on each side, one on the prosoma, the other at the base of the first cirrus, the latter being very long and delicate. *Anal appendages* as in *L. anserifera*.

MOUTH PARTS much like those of *L. anserifera*, but the inner angle of the mandible is more slender and has a much stouter fringe of bristles on the lower than on the upper margin.

Closely as this form appears to resemble some specimens of *L. anserifera* externally (*cf.* Pilsbry, *Bull. U. S. Nat. Mus.*, No. 60, pl. viii, fig. 3) I assign it to *L. anatifera*, mainly on the ground of the characters exhibited by its lateral appendages. It agrees as regards the markings on its terga and scuta with Darwin's var. A of the latter species, but differs in other respects, notably as regards the ridges on the peduncle, which seem to be a constant and characteristic feature. How far it is identical with the specimens in Prof. Herdman's collection from Ceylon I am not now in a position to say, as I only reserved one of these specimens, and that one an example in a bad state of preservation. At the time I examined Professor Herdman's collections, moreover, I had not had the same experience as regards the Lepadidæ as that which the examination of large numbers of specimens has since given me.

Subgenus DOSIMA, Gray.

The only species of this subgenus as yet known (*L. fascicularis*, Ellis and Solander) has not yet been taken in Indian seas but was obtained by the "Siboga" in the Malay Archipelago (whence it was also recorded by Darwin), and therefore may occur in our waters also. There are no Oriental specimens in the collection. I quote Darwin's description for convenience of reference:—

> "Valves smooth, thin, transparent; carina rectangularly bent, with the lower part expanded into a flat oblong disk. Filaments five on each side; segments of the three posterior cirri with triangular brushes of spines."

The peduncle is often surrounded by a globular mass of dead vesicular substance, and several individuals are not infrequently joined together by means of a mass of the kind secreted by them in common.

Subgenus Hyalolepas, nov.

Lepas tenuivalvata (Annandale).

Dichelaspis tenuivalvata, *Annandale, Spolia Zeylanica*, iii, p. 193, figure (1906); Lepas tenuivalvata, *id.*, in *Herdman's Report on the Marine Biology of Ceylon* (Roy. Soc.), pt. v, Cirripedia, p. 139 (1906).

The only known species of this subgenus was described in 1906 by myself as *Dichelaspis tenuivalvata*; in the same year (see synonymy above) I transferred it to the genus *Lepas*. The specimens were found attached to a sea-snake taken off the coast of Ceylon, and the species is evidently adapted to a pelagic life. I am now not at all sure that I was right in regarding the specimens as immature; in any case the lack of calcification exhibited by the valves is not due to immaturity.

Diagnosis—

Capitulum transparent, strongly compressed, flat on the surface; carinal margin rounded; occludent margin sinuous, slanting outwards from above; lower margin straight, horizontal; aperture large. Valves very imperfectly calcified, transparent, only the tergum and the upper part of the scutum and carina having a definite outline. *Carina* forked below, with two long basal branches, the distal parts of which disappear gradually without definite outline; the dorsal branch narrow, somewhat irregular in outline, often bearing a short tooth on the outer surface near the tip, which is situated nearer the apex than the base of the tergum; no ridge on the external surface. *Tergum* with the carinal and scutal margins nearly equal, each more than three times as long as the carinal margin; the apical angle rounded. *Scutum* separated narrowly from the tergum and carina, large but with only its tergal margin at all well defined, gradually disappearing towards the base of the capitulum, so that its lower limits cannot be detected exactly.

Peduncle very short, less than a quarter as long as the capitulum, transparent, irregularly annulated.

Cirri, etc.—First cirrus with both branches rather narrow, the posterior being shorter than the anterior by about four joints. The anterior branch with 14 joints, having the anterior margin of each joint nearly straight and the posterior margin boldly convex; the last six joints bear at the distal extremity of their posterior margin a pair of short spines; the distal joint terminates in a crown of longer and slenderer bristles, while the anterior margin of each joint bears a dense fringe of long hairs. The posterior ramus barely stouter than the anterior at the base; the distal joint ending in a fine bristle; the four penultimate joints bearing short spines on their distal extremity on and near the posterior margin, the number of these spines differing on the different joints and probably variable. Remaining cirri not very widely separated from the first pair, moderately long, slender; the distal joints (six to ten) each bearing several short spines at the distal extremity of the posterior margin, with a bunch of bristles at the tip of the last joint; the anterior margin of each joint with a dense fringe of bristles and hairs. *Anal appendages* each consisting of a single claw-

shaped joint, which bears on its posterior margin a series of very minute chitinous points; on the narrow, distal part of the appendage these become longer and are arranged in annular series; they are absent from the basal part of the anterior margin. *Penis* long and slender, rounded at the tip, indistinctly annulated in the middle, bearing numerous fine, scattered hairs. One filamentous appendage on each side.

MOUTH PARTS.—*Labrum* feebly or not at all bullate. *Outer maxilla* broad and short. The palp conical, with a dense fringe of rather short bristles on its outer margin. *Maxilla* with the free edge very broad, armed at the outer extremity with a single stout spine and two more slender spines of unequal length, which are followed by a deep, wide excavation; following this are two shallow excavations separated by rather wide prominences, the whole edge being armed with numerous bristles. *Mandible* with six teeth including the internal angle; the five innermost subequal, the external tooth being larger than, and rather widely separated from, the others; the whole of the sixth tooth, the outer margin of the fifth, fourth, third and second, and the excavation between the second and the external tooth, bearing very short spines.

The only known specimens of this species were taken on a sea-snake (*Hydrus platurus*) off the coast of Ceylon; some of them are now in the Colombo Museum, the remainder in Calcutta.

Genus CONCHODERMA, Olfers (1814).

Darwin defines this genus as follows:—

"Valves 2 to 5, minute, remote from each other; scuta with two or three lobes, with their umbones in the middle of the occludent margin; carina arched, upper and lower ends nearly alike.

"Filaments seated beneath the basal articulations of the first pair of cirri, and on the pedicels of four or five anterior pairs; mandibles with five teeth, finely pectinated; maxillæ step-formed; caudal appendages, none."

The relations between *Conchoderma* and *Lepas* are comparable to those between *Dichelaspis* and *Pœcilasma*, but are much less close. Nothing that can be called an intermediate form is known, for the degeneration in the valves of *Lepas tenuivalvata* is of a wholly different kind from that which has taken place in *Conchoderma*, nor does the former lack caudal appendages or possess a large number of lateral filaments. Indeed, it would rather appear that the two genera were offshoots from a common stock than that one was an offshoot from the other.

The only known forms, according to the view adopted here, that can be distinguished as species are *C. virgatum* (Spengler) and *C. auritum* (Linn.). Both of these species are said by Darwin to be "mundane," but I can find no definite record of the occurrence of *C. auritum* in the Indian Ocean, although it is apparently common in all parts of the Atlantic and Pacific.

Both species are commonly found attached to floating objects or pelagic animals, but *C. virgatum* also occurs at the bottom, both on inanimate objects and on crustacea.

Conchoderma virgatum (Spengler) (1790).

C. virgatum, *Darwin, Mon. Cirr.*, Lep., p. 146, pl. iii, fig. 2 (1851); *Hoek, "Challenger" Rep. Zool.*, vol. viii, Cirr., p. 55, pl. ii, figs. 13—15; *Turner, Trans. Roy. Soc. Edinburgh*, xli (ii), p. 430, pl. 1, fig. 3 (1905); *Annandale, Illustr. Zool. "Investigator,"* Crust. Ent., pl. v, figs. 2, 3 (1908).

C. hunteri, *Darwin, op. cit.*, p. 153, pl. iii, fig. 3; *Stebbing, Willey's Zool. Res.*, Crust., part v, p. 676; *Borradaile, Gardiner's Zool. Geograph. Laccadive and Maldive Arch.*, part i, p. 441.

Capitulum flattened, gradually blending into the peduncle; summit square or obtusely pointed. Membrane thin. Valves small, thin, sometimes imperfectly calcified, very variable in shape and in proportional length and, therefore, situated at variable distances from one another, but always remote and embedded in membrane. (Slightly modified from Darwin.)

Darwin recognized three species of this genus but acknowledged *C. hunteri* as distinct from *C. virgatum* with some doubt. Hoek was prepared to unite these two and to recognize only *C. auritum*, a very distinct species, apart from *C. virgatum*. In this course I have followed Hoek, after examining a considerable number of specimens externally and dissecting several. The one constant difference between *C. virgatum* and *C. hunteri* is that of colour, and even this difference is not absolute. The species *C. virgatum* (*s. l.*) can be distinguished at once from *C. auritum* by the absence of the "ears" which form so conspicuous a feature of the capitulum of the latter. The membrane, too, is thinner and the lateral appendages have a different arrangement; for in *C. virgatum* there are none of these structures at the base of the second cirrus, while in *C. auritum* there are two in this position.

Fig. 5.—First cirrus of *Conchoderma virgatum* var. *hunteri*, × 16.

The main differences which led Darwin to recognize *C. hunteri* as distinct were "the almost rectangular manner in which the upper portion of the tergum is bent outwards and along the orifice of the sack, the narrowness of all the valves, and especially the lateral lobes of the scuta, and lastly, the greater curvature of the carina, which in some specimens runs up far between the terga." None of these characters are constant in the specimens I have examined. The tergum in some is straight, being broader at its occludent end than at its carinal; in others it is angularly bent as in Darwin's specimens; in a few it is absent. Similarly, the carina is almost straight in some specimens, strongly arched in others, sinuate in others. The scuta vary in size, in the degree to which they are calcified, and in the relative lengths of the three branches. The one constant character about them is that they are Y-shaped, never

approaching a triangle in outline. As regards colour, the smaller specimens from Sumatra, and all those from the Bay of Bengal that I have seen have been transparent, tinged with a vinous shade, and sometimes—by no means always—showing in certain lights feeble traces of darker vertical bars. The larger specimens from Sumatra, having a capitulum of a little more than 10 mm. in length, are of a deep purple colour, without markings, the peduncle being stained with violet-blue and the membrane being opaque owing to the accumulation of pigment in its internal layer. I should have been prepared to retain *C. hunteri* as a subspecies, as I did in the last number of the "Investigator" Illustrations, had it not been for the examination of several specimens from Sumatra, kindly sent me by Dr. van Kampen, and for the fact that the scutum is distinctly Y-shaped in a striped specimen from a ship from Brazil presented to the Indian Museum some years ago by Prof. E. Cornalia. This specimen is but little different as regards the terga and scuta from one from the mouth of the river Hughli I have recorded elsewhere (*Journ. Asiat. Soc. Bengal* (N. S.), vol. ii, p. 207, 1906) but is very much more distinctly striped. It is figured in the "Investigator" Illustrations, pl. v, fig. 2. Dr. van Kampen's large specimens are very dark and show no trace of stripes, but the whole series exhibits great variation as regards the terga and carina, the latter being wholly absent or represented by minute rudiments in several instances. The peduncle is much longer relatively in the small individuals than it is in the darker and larger ones.

There seems to be considerable variation as regards the mouth parts of *C. virgatum*. The mandible (fig. 6) is liable to be distorted, as one of Hoek's specimens of the

FIG. 6.—Mandible of *C. virgatum* var. *hunteri*, × 46.

var. *chelonophilus* showed, and, apart from this, varies as to the pectination of the six teeth which, including the inner angle, are present in normal individuals. In one specimen I dissected I found that on one side the row of small, triangular projections that constitute the pectination was near the upper edge of each tooth, while on the other it was near the lower; in neither was it on the edge. The innermost tooth (inner angle) is very short and narrow, and may be either straight or project at an angle. The two teeth next it in my specimens are much shorter than the one next them on the other side. Darwin describes the maxilla (fig. 7) as having five steps on

the free edge. In my specimens the first step is a rather deep incisure, only bearing slender bristles at its base, while each of the others bears either six or eight stout spines arranged in two parallel rows; there are three stout spines external to the uppermost step, the outermost spine being the largest and the other two being parallel and not in line.

Fig. 7.—Maxilla of *C. virgatum* var. *hunteri*, × 50.

The penis is long and stout, not minutely annulated, but with irregular transverse wrinkles on its distal half. The tip is obtusely pointed and bears a thin tuft of short hairs. The dorsal half of the proximal part bears numerous long, slender hairs, which make their appearance also on the ventral half towards the tip. The external surface is coloured of a faint and uniform vinous tinge, which pervades the whole of the animal's integument, including the mouth parts, and is due to the presence of innumerable very minute pigment cells.

Although, owing to the existence of intermediate forms, I do not consider it advisable to divide the species into subspecies or local races (see p. 68, *antea*), it must be acknowledged that it is possible to distinguish several varieties which have a certain stability. They may be recognized as follows:—

Var. I (typical form).—Capitulum square above, with well-defined vertical bars of a darker colour than the rest of the membrane. Scutum trilobed but not Y-shaped, the three lobes of equal length. Tergum somewhat sinuate.
Habitat.—Atlantic and Arctic Ocean, Pacific, Mediterranean.

Var. II (*intermedia*, nov.).—Tergal margin of the capitulum forming an angle considerably greater than a right angle with the carinal margin; stripes distinct. Tergum straight. Carina somewhat sinuate or angulate. Scutum Y-shaped; the lobe pointing towards the carina shorter than the other two.
Habitat.—On bottom of ship from Brazil (*Cornalia*).

Var. III (*Cineras hunteri*, Owen).—Upper part of capitulum not or barely angulate behind. Stripes obsolete or obsolescent. Tergum straight or nearly so. Carina usually arched. Scutum narrowly Y-shaped.
Habitat.—Indian Ocean, S. Pacific.

Var. IV (*Cineras olfersii*, Leach).—Summit of capitulum bluntly pointed; stripes present, but sometimes of a faint colour. Terga straight. Scutum tri- or quinquelobate, the three main lobes of equal or nearly equal length, meeting one another in such a way as to form two right angles, or one angle slightly greater than and one slightly less than a right angle.
Habitat.—Mediterranean, Atlantic.

The characters by which the form called *Cineras olfersii* by Leach is distinguished from the same author's var. *chelonophilus* appear from Hoek's description of the latter to be so variable (and certainly are so variable in the variety *hunteri*) that it seems to be impossible to separate the two even as varieties.

I have already (p. 68, *antea*) discussed the distribution[1] of the varieties of *C. virgatum*, but it may be as well to state in greater detail what is known as to the objects to which they commonly affix themselves. The typical form is common on ships' bottoms, on the skin of whales, and even of slow-moving fish (Darwin), on the copepod parasites of whales and fish (Turner); and still more so on the sessile barnacles (*Diadema*) commonly found attached to whales. The variety known as *chelonophilus* is stated by Darwin to be found on one species of turtle, *viz.*, "*Testudo*" *caretta*, but several specimens are recorded as from *Chelone* sp., and the number actually examined by students of the Cirripedes appears to have been small. The variety *hunteri* has usually been taken on the sea-snake *Hydrus platurus*, but has also been found attached to a telegraph cable and to the carapace of a crab; the specimen from the mouth of the river Hughli, now in the collection of the Indian Museum, was apparently attached to a turtle. There does not, therefore, seem to be evidence that any of the varieties of the species is confined to one particular host. Although *Conchoderma virgatum* is reported to be a common species, the actual number of specimens recorded is by no means a large one.

Genus HETERALEPAS, Pilsbry (1907).

Capitulum naked or provided with a pair of ill-defined chitinous scuta, the capitular membrane greatly thickened and more or less wrinkled on the surface; the muscles of the peduncle extending upwards into the capitulum and forming a layer beneath the membrane. A single lateral appendage on each side, situated at the base of the first cirrus. Anal appendages long, multiarticulate. Mandibles usually with four teeth, the base of which bears numerous small spines; maxillæ excavated, their biting edge often irregular.

This genus is divided by Pilsbry into two subgenera in accordance with the structure of the fifth and sixth pairs of cirri. In the subgenus *Paralepas* the two rami of each of these appendages are approximately equal, while in the more typical forms the internal (posterior) rami are much reduced, being distinctly smaller and less well armed than the external (anterior) rami.

[1] Since this paper was in the press I have found a small example of the typical form of the species on the leg of a turtle (*Chelone imbricata*) from the Bay of Bengal.—*May 3rd*, 1909.

There can be little doubt that the degeneracy of these rami brings the subgenus into close relationship with the Alepadinæ, and it is noteworthy that the mandibles of the species of both subgenera show a certain approximation in form to those of the species of that degenerate subfamily. Degeneracy in the mandibles consists, however, very largely in a reduction in the number of their teeth, and it must be noted that a reduction of the kind takes place occasionally, as an individual peculiarity, in widely separated families. For instance, in some examples of *Pœcilasma minutum* two of the central teeth fuse together, as a rule only on one mandible ; while in the specimen of *Scalpellum sociabile* which was first dissected the large outer tooth of both mandibles had completely disappeared, although in other specimens from the same locality since examined it has been found to be well developed.[1] However this may be, it seems clear that the genus *Heteralepas* (*sensu lato*) affords a link between the subfamilies Lepadinæ and Alepadinæ. It may be necessary later, however, as Pilsbry points out, to separate *Paralepas* from *Heteralepas* as a distinct genus.

Only two species of *Heteralepas* have been as yet recorded from Indian seas, one representing each subgenus. They are—

Heteralepas (*Paralepas*) *xenophoræ*, mihi,

and

Heteralepas (*Heteralepas*) *nicobarica*, sp. nov.

Subgenus Paralepas, Pilsbry.

Heteralepas (*Paralepas*) *xenophoræ* (Annandale).

Alepas xenophoræ, *Annandale*, *Ann. Mag. Nat. Hist.* (7), vol. xvii, p. 399 (1906); *Illustr. Zool. "Investigator,"* Crust. Ent., pl. ii, figs. 5, 5a, 5b ; *Hoek*, *Siboga-Exped.*, Mon. xxxi*a*, Cirr. Ped., p. 39.

Capitulum subtriangular, pointed at the apex, slightly inflated below the aperture (at the base of which there is a distinct constriction), marked with transverse striæ. Aperture slit-shaped, with barely protuberant lips, rather less than a third as long as the vertical length of the capitulum. No scuta.

Peduncle stout, irregularly but finely annulated, longer than the capitulum.

Cirri, etc.—Cirri short and feebly curved, with the pedicel long as compared with the rami. First cirrus widely separated from the second, each of its rami with five distinct joints, of which the proximal joint equals the sum of the others in length ; the anterior ramus with a soft, easily broken cylindrical process at its tip ; this ramus distinctly broader than the other and longer by one complete joint ; the basal joint of each ramus broadly convex outwards on the posterior margin, the other joints having this margin nearly straight and the anterior margin more or less convex ; each joint of both rami bearing a circle of stout feathered bristles round its distal extremity and each basal joint with a dense fringe of similar bristles running down both

[1] I have satisfied myself that this is so by re-examining my preparations of the type specimen, and by dissecting several others [*see Mem. Asiat. Soc. Bengal*, vol. i, p. 78, fig. 2 (1906)].

margins. The other cirri similarly armed except as regards the basal joints; the circle of bristles incomplete on all except the last few joints in each case. The two rami of the fifth and sixth cirri almost equal. *Anal appendages* long and slender, with about twelve joints, somewhat variable. *Penis* slender and rather short, very minutely and obscurely annulated, bearing a small number of fine, scattered hairs on the proximal part and a few rather coarse, short, flattened hairs on the distal; the whole organ tapering, but the extreme tip minutely blunt, the base contorted.

MOUTH PARTS.—*Labrum* moderate, not bullate. *Maxilla* with free edge slightly irregular; the outermost spine much larger than any of the others; a number of subequal spines arranged all along the edge, with a bunch of stout hairs near the inner end. *Mandible* with four teeth, the innermost with a short, sharp projection on its inner margin near the tip; the bases of all the teeth near together and on a wide arc; the tip of the innermost tooth sharply pointed, the remainder rather blunt; slender spines arranged in a semicircle parallel to the excavation between the third and fourth teeth, in a dense mass at the base of the first and second teeth and almost all over the innermost, forming a fringe on the inner border of the latter.

Length of capitulum	12 mm.
Breadth ,, ...	10 ,,
Length of aperture	4 ,,
,, peduncle	7 ,,

HABITAT.—Off the S.-W. of India, 185 fathoms. Four specimens on shell of living *Xenophora pallida* (R.I.M.S. "Investigator").

Hoek (*loc. cit.*) was undoubtedly right in considering his *Alepas obliqua* from the Malay Archipelago as an ally of this species. My species appears, however, to be a stouter one and to exhibit distinct differences in the mouth parts, cirri, etc. Both species are interesting in that their cirri are short and almost straight, thus showing an approximation to the Alepadine type, although neither is pelagic.

Subgenus HETERALEPAS, Pilsbry.

Heteralepas (*Heteralepas*) *nicobarica*, sp. nov.

Alepas indica, *Annandale* (nec *Gruvel*), *Mem. Asiat. Soc. Bengal*, i, p. 83 (1906).

All the tissues delicate and transparent, with a slight yellowish tinge in spirit. External surface smooth or minutely wrinkled.

CAPITULUM indistinctly separated from the peduncle, slightly inflated, without scuta; the occludent margin nearly straight, the carinal margin rounded, bearing a very low crest with two small projections. Aperture about one-quarter as long as the vertical length of the capitulum, with short fringed lips and almost parallel sides.

PEDUNCLE several times as long as the capitulum in some specimens, not much longer than the capitulum in others, cylindrical, stout, expanding slightly at the base.

CIRRI, etc.—Cirri with a large number of joints, long and curved. First cirrus not very widely separated from the second, with the two rami subequal, each joint bearing a fringe of stout bristles across its anterior margin. Second cirrus much shorter

than the fourth. The fully developed rami of the posterior cirri armed like those of the first pair, except that on the greater number of the joints (all but the first few at the base) they bear only one transverse pair of bristles on each joint with a number of fine hairs between them ; hairs at the tip of the joints behind few and short. The posterior rami of the fifth and sixth cirri very fine, having 17 and 15 joints respectively, while the anterior rami have a very large number ; the hairs on the posterior rami short and extremely fine, confined to the tip of the distal joint (which is small and cylindrical) and to the distal end of the posterior margin of the last ten joints. *Anal appendages* very slender, consisting of about nine joints and extending slightly beyond the distal end of the pedicel of the sixth cirri ; the bunch of hairs at the tip short and sparse. *Penis* moderately long and slender, cylindrical, pointed at the tip, minutely annulated, bearing a few scattered hairs on the surface and a bunch of similar hairs at the tip.

Mouth parts.—*Mandibles* not bullate, bearing a sparse row of minute, rounded, chitinous teeth. *Maxillæ* narrow ; the biting edge with a rather shallow incisure, at the base of which there is a small, conical projection ; the outermost spine by far the largest. *Mandible* with five teeth, the inner angle being dichotomous ; the outer tooth the largest, pectinate at its base on the inner margin, separated from the other teeth by a deep but not very broad incisure ; second, third and fourth teeth subequal, the innermost tooth very small ; second tooth pectinated at the base on the inner margin.

Habitat.—Nicobar Islands, on floating wood (*de Roepstorff*). Ten specimens in rather bad condition.

This species bears a close external resemblance to Gruvel's figures of his *Alepas indica* from Singapore. It appears, however, to differ considerably from that species, with which I formerly confused it, in the structure of its cirri and mouth parts. The largest specimen I have seen measures 40 mm. in total length, but the peduncle in all is somewhat curved.

Subfamily *PŒCILASMATINÆ*.

Key to the Genera.

1. Valves fully calcified, covering the whole or nearly the whole of the capitulum.
   - (*a*) Carina not expanded laterally at the base .. .. *Pœcilasma.*
   - (*b*) Carina expanded laterally at the base .. .. *Megalasma.*
2. Valves more or less degenerate and separated from one another ; at least one calcified valve as a rule present.
   - (*a*) Scutum split into two segments, which diverge from one another above, or reduced to a vertical linear rudiment .. *Dichelaspis.*

Genus Pœcilasma, Darwin (1851).

Lepadidæ with 3, 5 or 7 fully calcified, approximate valves. The scutum broad, entire or split into two vertical segments, of which the occludent segment

is narrower than the carinal; umbo at the rostral angle. Tergum triangular or nearly so, absent in one species. Carina forked at the base or expanded into a more or less well-developed transverse disk, not expanded vertically; its apex reaching or extending for a short distance between the terga above; its umbo basal. Peduncle well developed, naked, or bearing small chitinous plates. Filamentous appendages absent; caudal appendages consisting of a single joint, cylindrical or laterally compressed, not claw-shaped, bearing at the tip a pencil of fine hairs. Mandibles with four or five (rarely six) teeth, inclined to be variable; maxillæ with the free edge straight or broken by a single incisure, not step-formed.

This genus is easily distinguished from *Lepas* by the structure of its anal appendages and maxillæ; it fades almost imperceptibly into *Dichelaspis*, from which it is only distinguished by the perfect development of its valves. From *Megalasma*, Hoek, it is distinguished by the shape of the carina at the base—a character which is perhaps of no more than subgeneric value.

Strictly speaking, as Darwin was well aware and as Pilsbry has recently pointed out, the name of the genus should be *Trilasmis*, for a species was described under that name by Hinds in 1844. The species (*T. eburnea*), however, was an aberrant one, and the name has so long been obsolete that to revive it would only cause confusion. I have therefore neglected to follow the strict laws of priority in this instance, retaining Hinds's name merely as that of a subgenus.

Four[1] Indian species of *Pœcilasma* are known; they may be distinguished as follows:—

Key to the Indian species of Pœcilasma.

I. Valves complete; scutal margin of tergum straight.
   A. Carina narrow, truncated at the base .. .. *P. kæmpferi.*

II. Scutum divided vertically; scutal margin of tergum straight.
   A. Tergum with the occludent and apical angles more or less rounded and the carinal angle truncate .. .. *P. fissum.*

III. Scutum divided vertically; tergum present, its scutal margin excavated to correspond with the tip of the occludent margin of the scutum.
   A. Valves closely approximate; occludent margin of the scutum strongly curved .. .. .. *P. minutum.*

IV. Tergum absent; scutum inflated.
   A. Scutum with a strong internal tooth, not divided, but possessing a distinct vertical suture .. .. *P. eburneum.*

[1] The specimens identified as representing *P. gracile*, Hoek (*Rec. Ind. Mus.*, vol. i, p. 81 (1907), are young examples of *Megalasma minus*, which, at an early stage, closely resembles *P. gracile* externally.

Each of these four species represents a distinct section of the genus, and there can be no difficulty in separating one from the other. Each, however, is represented (with the exception of *P. eburneum*) in other parts of the Indo-Pacific region by closely allied or racial forms, which must be separated, if they are really distinct, with the greatest care. On the whole I think it best to regard *P. eburneum* as the type of a distinct subgenus, for which the name *Trilasmis*, Hinds, is available.

Pœcilasma kæmpferi, *P. fissum* and *P. eburneum* all appear to have an extensive distribution. This is especially the case as regards the first, which occurs (either in the typical form or so modified as to constitute a local race) on both sides of the Atlantic, off the coast of Japan in the S. Pacific and in the Malay Archipelago, as well as in the Gulf of Manaar. *P. fissum* was originally described from the Philippines and has since been recorded from the Malay Archipelago and from several localities in the S. Pacific; while *P. eburneum* was first discovered at New Guinea and has since been found in other parts of the Malay Archipelago and in the Persian Gulf and the Red Sea. The original locality of *P. minutum* was Singapore; I have examined many specimens from the Bay of Bengal and the Arabian Sea.

The different species differ considerably as regards their bathymetric range. *P. kæmpferi* is a deep-sea form, probably to be found only below the 100-fathom line. *P. fissum* and *P. eburneum*, on the other hand, belong to the littoral fauna. *P. minutum* is abundant in the Arabian Sea at a depth of between 100 and 200 fathoms.

Several species of *Pœcilasma* show a preference for Echinoids, to the spines of which they are commonly found attached. This is the case as regards *P. eburneum*. I have noticed that all the specimens I have examined have been fixed to the spines on the oral surface of the host, in which position it is probable that stray fragments of the Echinoid's food are more easily obtained by the barnacle than if it were attached to spines on the anal or lateral surface.

P. kæmpferi and its local races are usually attached to the carapace of spiny crabs, but have also been found on sea-urchins; while *P. minutum* apparently adheres to any crustacean which it meets at the critical stage of its development. I have found it most commonly on the carapace of *Panulirus angulatus*, but have taken two specimens on the capitulum of *Pœcilasma kæmpferi*. I have also found specimens on the carapace and even in the gill-chambers—but there rarely—of several crabs.

The following table gives a statement of the distribution, etc., of the Indian species of the genus. I have dealt with these points in greater detail as regards the species of the genus *Dichelaspis*, as I have more information about them than I possess as regards those of the present genus. As a matter of convenience the two Indian species of *Megalasma* are included in the same table—a position which the similarity in structure and habits between the two genera abundantly justifies.

Distribution, etc., of Indian species of Pœcilasma *and* Megalasma.

Name of Species.	Localities.	Hosts.	Bathymetric Distribution.
Pœcilasma kæmpferi, Darwin (with local races).	PACIFIC: Japan (*Darwin*, *Weltner*, *Pilsbry*); Sandwich Islands (*Pilsbry*). MALAY ARCHIPELAGO: Lat. 5° S., Long. 132° E. (*Hoek*). BAY OF BENGAL: Gulf of Manaar. EAST ATLANTIC: Madeira (*Darwin*); off C. Bojador (*Gruvel*); C. Verde Islands. WEST ATLANTIC: Off New Jersey (*Pilsbry*); off C. Florida (*Pilsbry*).	DECAPOD CRUSTACEA: *Inachus kæmpferi*, *Echinoplax pungens*, *Eupagurus politus*, (?) *Lithodes agassizii*, *Scyramathia carpenterii*, *Eumunida picta*, *Geryon quinquedens*, *G. affinis*, *Cyrtomaia smithi*, *Lumbrus stellatus*. ECHINODERMA: *Dorocidaris papillata*.	163 and 101 fathoms (Malay Archipelago, *Hoek*); 185 fathoms (G. of Manaar); 125—430 fathoms (E. Atlantic, *Gruvel*); 170 and 1,120 fathoms (W. Atlantic, *Pilsbry*); 164—338 fathoms (S. Pacific, *Pilsbry*).
Pœcilasma fissum, Darwin ..	PACIFIC: Bonol, Philippines (*Darwin*); New Caledonia (*Fischer*); Port Jackson (*Whitelegge*); Jaluit (*Weltner*); Honolulu (*Schaunsland*). MALAY ARCHIPELAGO: Lat. 5° S., Long. 132° E.; Lat. 7° S., Long. 115° E. (*Hoek*). BAY OF BENGAL: Andamans (*Blanford*).	DECAPOD CRUSTACEA: *Palinurus* sp. (*Weltner*, *Hoek*); "Spinose crab" (*Darwin*).	Low water (*Darwin*). Apparently littoral.
Pœcilasma minutum, Gruvel ..	MALAYA: Singapore (*Gruvel*). ARABIAN SEA: Lat. 7° N., Long. 77° E.; Lat. 17° N., Long. 57° E. BAY OF BENGAL: Lat. 11° N., Long. 92° E.; Gulf of Manaar.	DECAPOD CRUSTACEA: *Panulirus angulatus*, *Paralia alcockii*, *Homola megalops*. (Generally external, occasionally at entrance to gill-chamber.) CIRRIPEDE CRUSTACEA: Capitulum of *Pœcilasma kæmpferi*; peduncle of *Alepas indica*.	143 fathoms; between 156 and 200 fathoms; between 180 and 220 fathoms; 185 fathoms.
Pœcilasma eburneum (Hinds)..	MALAY ARCHIPELAGO: New Guinea (*Hinds*); Street Molo (*Hoek*); Borneo Bank (*Hoek*); off Sumatra (*van Kampen*). PERSIAN GULF (*Lloyd*). RED SEA (*Weltner*).	ECHINODERMA: Spines of *Echinus* spp., *Cidaris bispinosa* and other Echinoids.	Littoral zone; 48 fathoms (Persian Gulf); 13-14 fathoms (Sumatra).
Megalasma minus, Annandale. Syn. *M. lineatum*, Hoek.	BAY OF BENGAL: Andaman Sea; off S. India. ARABIAN SEA: W. of Laccadive Islands. MALAY ARCHIPELAGO: Lat. 5° 3′ S., Long. 119° E. (*Hoek*).	ECHINODERMA: *Goniocidaris florigera* (*Hoek*); various Cidaridæ. PORIFERA: *Pheronema raphanus*.	200—500 fathoms (Indian seas); 67 fathoms (*Hoek*).
Megalasma carino-dentatum, Weltner.	BAY OF BENGAL: Lat. 11° N., Long. 88° E.	PORIFERA: *Hyalonema masoni*.	1,748 fathoms.

Subgenus Pœcilasma, Darwin.

Pœcilasma kæmpferi, Darwin.

P. kæmpferi, *Darwin, Mon. Cirr.*, Lep., p. 102, pl. ii, fig. 1; *Gruvel, Zool. Travailleur et Talisman*, Cirrhipèdes, p. 46, pl. iv, fig. 1; *Weltner, Archiv. f. Naturg.*, 1897 (i), p. 243; *Pilsbry, Bull. Bureau of Fisheries*, vol. xxvi (1907), p. 183, and *Bull. U. S. Nat. Mus.*, No. 60, p. 84, pl. vi, figs. 1—5, 13 and 14; *Annandale, Illustr. Zool. "Investigator,"* Crust. Ent., pl. iii, fig. 1.

P. aurantium, *Darwin, op. cit.*, p. 105, pl. ii, fig. 2; *Hoek, Siboga-Exped.*, Mon. xxxi*a*, Cirr. Ped., p. 7.

P. dubium, *Hoek, op. cit.*, p. 6, pl. i, figs. 2—4, pl. x, figs. 1a—d.

Capitulum more or less narrowly ovate; the carinal margin much more strongly arched than the occludent margin; apex pointed, valves five, stout, closely approximate. *Tergum* triangular; the carinal angle slightly truncated, the others sharp; the scutal margin straight. *Carina* arched, ending in a very small and imperfect disk at the base, tapering above, almost of the same width throughout or widest at the base; above extending a short distance between the terga. *Scutum* entire, much longer than broad, with a more or less distinct ridge running down it near the occludent margin; internal umbonal teeth feebly developed or strong.

Peduncle slender, variable in length, ringed, naked.

Cirri, etc.—Rami of first cirrus nearly equal; second cirrus widely separated from first. *Anal appendages* about $\frac{1}{3}$ length of the pedicel of the sixth cirrus, with bristles at the tip and down the whole of the posterior margin. *Penis* long, stout, hairy.

Mouth parts.—*Mandibles* variable. *Maxilla* has "two large upper spines, the edge deeply notched below them, sparsely spiny in the notch. It then protrudes and is rather closely set with spines" (Pilsbry).

Several forms have been described which seem to be subspecies or local races of *P. kæmpferi*. The Indian specimens I have examined do not quite agree with any figure I have seen. Unfortunately I have only been able to examine six individuals from any Oriental locality. All of them were taken in the Gulf of Manaar on the shell of a "spinose crab" (*Echinoplax pungens*) at a depth of nearly 500 fathoms. They come nearest to the form recently described by Hoek as *P. dubium*, but their carina is intermediate between that of this form and that of the specimen figured by Darwin. Pilsbry's figure, however, of the carina of a Japanese specimen does not altogether agree with Darwin's, although the latter's specimen was also from Japan. In my specimens the occludent margin projects less beyond the vertical ridge on the scutum than it does in Hoek's figure, but a little more than it does in Darwin's. On the whole, I think that it is possible to distinguish five local races of the species, and that they may be distinguished as follows:—

Race I (typical form).—A single vertical ridge on the scutum. Occludent margin of the scutum projecting very little beyond the vertical ridge, evenly curved;

maximum length of scutum to maximum breadth about as 5 to 3. Carina of almost the same width throughout when viewed laterally.
Habitat.—Japan and S. Pacific.

Race II (*P. dubium*, Hoek).—A single vertical ridge on the scutum. Occludent margin of scutum regularly curved but separated from the vertical ridge by a more or less considerable interval; maximum length of the scutum to maximum breadth about as 2 to 1. Carina tapering from below upwards when viewed from the side.
Habitat.—Seas of India (Gulf of Manaar) and the Malay Archipelago.

Race III (*P. aurantia*, Darwin).—A single vertical ridge on the scutum. Occludent margin of the scutum protuberant and irregularly curved; the greatest length of the scutum to the greatest breadth about as 12 to 7. Carina broadest at the base when viewed from the side. Concentric striæ on the valves less marked than in the other forms; valves more or less yellowish.
Habitat.—E. Atlantic, off W. Coast of Africa.

Race IV (*P. kæmpferi litum*, Pilsbry).—Very close to the last, from which it is distinguished mainly by the greater protuberance of the occludent margin of the scutum. Perhaps it should not be considered distinct.
Habitat.—W. Atlantic, off the coast of Florida.

Race V (*P. kæmpferi novæangliæ*, Pilsbry).—Curve of the occludent margin of the scutum regular, but separated by a considerable distance from the vertical ridge, which is very distinct. There is a second vertical ridge on the valve, less distinct than the first and approaching it at an angle. Carina very slightly wider at the base than above when viewed from the side.
Habitat.—W. Atlantic, off the coast of New Jersey.

In drawing up this table I have been obliged to depend very largely on the figures published by Darwin, Gruvel, Hoek and Pilsbry, but, apart from the specimens from the Gulf of Manaar, I have examined a small individual of the New England race which I found on the carapace of a crab (*Geryon quinquedens*) from off Martha's Vineyard, New Jersey, and a number of specimens of the race *aurantia* which have been sent me by Prof. Bouvier and were originally attached to the type specimens of *Geryon affinis*. Even before consulting Pilsbry's paper I had no difficulty in identifying the New Jersey specimen as representing a form of *P. kæmpferi*. There can be no object, I think, in separating the Indian from the Malayan race, at any rate until more examples of the form have been examined; in drawing up the definition of Race II I have made use of my examination of the specimens from the Gulf of Manaar as well as Hoek's description and figures. The length of the stalk is so variable a character in other species of the genus that I have not alluded to it. In *P. minutum* I find that while the stalk is usually short, about one individual in fifty has it of several times the normal length. One of the specimens of *P. kæmpferi* from the Gulf of Manaar is figured in the last part of the "Investigator" Illustrations (*tab. cit. supra*).

Pœcilasma fissum, Darwin.

P. fissa, *Darwin, Mon. Cirr.*, Lep., p. 109, pl. ii, fig. 4 (1851).

P. fissum, *Hoek, Siboga-Exped.*, Mon. xxxi*a*, Cirr. Ped., p. 8, pl. x, figs. 2—5 (1907); *Annandale, Illustr. Zool. "Investigator,"* Crust. Ent., pl. iii, fig. 8.

P. amygdalum, *Aurivillius*, "Stud. ü. Cirr.," *K. Svensk. Vet.-Ak. Handl.*, xxvi, No. 7, p. 10 (1894).

? P. lenticula, *id.*, *ibid.*, p. 12.

Capitulum ovoid, narrowly rounded above, the carinal margin somewhat more boldly and more regularly arched than the occludent; valves not in close contact with one another. *Scutum* divided, the two segments often diverging to some slight extent above, the occludent segment narrow, especially so in its lower half, its upper extremity more or less pointed; carinal segment broad, slightly inflated, its anterior border almost straight, its tergal and carinal borders forming an almost uninterrupted curve. *Carina* reaching the basal angle of the tergum above, forming a very small transverse disk at the base, which is concealed beneath the cuticle; no definite dorsal or lateral ridges. *Tergum* subtriangular, the apex being more or less rounded; the occludent, and sometimes the carinal angle also rounded.

Peduncle short, irregularly annulated, often ornamented with small spines or plates.

Cirri, etc.—"*Cirri* of the first pair .....have unequal rami of respectively 6 and 9 segments. These segments are broad, short, quadrangular, bearing at the extremity a transverse row of numerous spines, which are longer than the segments themselves." "*Cirri* of the second to sixth pair.....have rather short pedicels and also short rami of 11 and 12 segments.....what is especially characteristic for this species is, that the pairs of spines which as a rule in other Cirripeds are seen at the anterior faces of the segments of the cirri are totally wanting" (Hoek).

Mouth parts.—"*Labrum* with a row of about 24 small teeth, standing close together; at each side the five or six outer ones are sharply pointed, the dozen in the middle being rather blunt. *Palpi* small, conical, with about five longer hairs at the tip and a few smaller ones along its inner side."

"According to Darwin the fourth tooth of the mandible is pectinated. I found a small tooth on the inner edges of the second and third teeth, one on the outer edge of the fourth tooth and also one on the edge of the inferior angle."

"The *maxillæ* were unknown to Darwin. The upper part.....is furnished with three spines: two claw-like and the third rather straight and more delicate; .... Under the upper part there is a deep notch, on the inferior margin of which two minute hairs are planted. The inferior part of the edge of the maxilla is much produced and bears about ten unequally stout spines. Of these the one placed about the middle is by far the strongest" (Hoek).

The species appears to be rare though widely distributed. Darwin examined a single specimen (dried) from the Philippines, Hoek found a large number on a "*Palinurus*" taken at Ternate, and others have been recorded by Weltner. The only

specimen in the Indian Museum was taken at the Andamans by the late Dr. W. T. Blanford and is figured in the "Investigator" Illustrations. It is probably immature. As we have only one small specimen I have quoted largely from Hoek in the description of the species.

Pœcilasma minutum, Gruvel.

P. minutum, *Gruvel, Trans. Linn. Soc.* (2), vol. viii, p. 288, pl. xxiv, fig. 5 (1902), Mon. Cirr., p. 120, fig. 138 (1905).

CAPITULUM somewhat broadly ovate, pointed above, varying in proportions considerably. Valves six, delicate and translucent, not very closely approximate above. *Tergum* triangular, the anterior part of the scutal margin deeply excavated to receive the apex of the occludent segment of the scutum, the umbo surrounded by an opaque, sculptured area. *Carina* narrow, not reaching the level of the apex of the carinal segment of the scutum above, broadening out slightly at the base and concave on the sides, terminating in a broadly oval transverse disk below, generally with a distinct dorsal ridge, and sometimes with a subterminal tooth above. *Scutum* split into two segments, with an opaque sculptured area surrounding the umbo at the base; the occludent segment much broader above than at the base, bluntly pointed or rounded when in contact with the tergum, the arc of the inner edge having a wider radius than that of the occludent margin; the carinal segment broad, convex outwards, without vertical ridges, its tergal margin straight, the carinal margin broadly arched, the basal margin not distinctly marked off from the carinal, the occludent margin corresponding with the inner margin of the occludent segment, with which it is in close contact.

PEDUNCLE very variable, often short and thick, sometimes longer than the capitulum and relatively slender, bearing numerous little round, yellowish chitinous plates, which are sometimes minute and inconspicuous.

CIRRI, etc.—First cirrus widely separated from the second, by no means broad, the anterior ramus reaching nearly to the tip of the penultimate joint of the posterior, the two distal joints of each ramus bearing a terminal circle of stout bristles and an anterior fringe of similar bristles, which is extended down the margin of the next one or two joints and disappears gradually towards the base of the ramus. Other cirri long and slender, bearing on their anterior margin numerous long, slender hairs, and at the distal extremity of the posterior margin of each joint a sparse bunch of similar hairs. *Anal appendages* slender, of variable length, falling short of, reaching or passing the basal joint of the sixth cirri, bearing at the tip a number of very long bristles, which extend a short distance down the posterior margin. *Penis* slender, moderately long, minutely annulated, pointed, bearing a short process on the dorsal surface near the tip and a few scattered hairs near the base.

MOUTH PARTS.—*Labrum* not bullate, bearing a row of minute equal, triangular teeth. *Outer maxilla* long and moderately broad, spatulate, bluntly rounded at the tip, bearing a row of short, stout spines on the distal third of the external surface. The palpi short, bluntly pointed, bearing a somewhat sparse fringe of stiff

hairs. *Maxilla* very large, deeply excavated, the excavation being narrow and much nearer the outer than the inner margin; three stout spines external to the excavation, internal to it five or six rather slender spines and a number of fine hairs; internal margin broadly serrated, hairy. *Mandible* normally with five teeth, including the inner angle, but this angle often dichotomous and the two teeth next it sometimes fused together, so that there might be either four or six teeth altogether; the two mandibles of the same individual not always symmetrical, the outer tooth much larger than and widely separated from the others; the inner margin pectinate.

This species, which was originally described from a single young individual, is a very variable one. I have dissected about a dozen individuals and examined over a hundred more externally. The three outlines in plate vii (figs. 5—7) illustrate the manner of variation of the valves; fig. 5 represents a very old individual and fig. 6 a young one.

A near relationship evidently exists between this species and Hoek's *P. excavatum*, from which it is easily distinguished by the shape of the occludent segment of the scutum. Both forms exhibit a marked similarity in their anatomy to the less degenerate species of *Dichelaspis* such as *D. tridens*.

Subgenus Trilasmis, Hinds (1844).

On the whole I think it advisable to regard Hind's *Trilasmis eburnea* as a type of a subgenus. Its peculiarities are so marked that it might even be justifiable to regard it as the type of a distinct genus. Hoek (1907) has, however, recently described a new species (*Pœcilasma obliquum*) which is to some extent intermediate between *Trilasmis eburnea* and the more typical members of the genus *Pœcilasma*. In any case *Trilasmis*, in which Hoek's *Pœcilasma obliquum* should be included, may be defined as follows:

Species of *Pœcilasma* in which the tergum is absent or quite rudimentary and in which the scutum is greatly developed and covers almost the whole of the capitulum.

Pœcilasma (*Trilasmis*) *eburneum*, Hinds.

Capitulum ovoid, broadly rounded above, the base pointed towards the occludent margin; external surface of the valves smooth. *Tergum* entirely absent. *Scutum* occupying almost the entire surface of the capitulum, ovoid, pointed at the base, inflated, not divided but having a distinct vertical suture not far from the occludent margin. *Carina* short, arched, broad laterally, concave internally, terminating at the base in a broad subquadrangular or circular disk directed downwards and inwards; a conspicuous ridge running down the valve on either side near its scutal margin and becoming more pronounced in the region of the disk.

Peduncle very short, placed obliquely as regards the capitulum.

Cirri, etc.—First pair of cirri widely separated from second, with the rami slender, subequal, each with about 10 joints, which are imperfectly developed at the base. The other cirri rather short, curved, the bunches of hairs on the posterior margin of

the joints long and well developed. *Anal appendages* uniarticulate, cylindrical, rather stout, rounded at the tip, which bears a bunch of bristles shorter than the appendage. *Penis* short, pointed, slender.

MOUTH PARTS.—*Labrum* with very small chitinous teeth, which become almost granular in the middle of the row. *Outer maxilla* very broad, truncated, subquadrangular, bearing numerous rather short and slender hairs on its inner surface. *Maxilla* excavated, bearing three stout spines external to the notch; the edge internal to the main notch somewhat irregularly sinuated or serrated, sometimes with a second notch not very much more shallow than the outer one; the spines on the internal part of the edge very stout; the greater part of the maxilla covered with fine, short hairs. *Mandible* bearing five teeth, the internal angle being dichotomous; the innermost tooth more or less spine-like; the notches between the teeth with their edges more or less irregular, but not definitely serrated or pectinate; the greater part of the mandible covered with fine, scattered hairs.

The largest specimen of the species that I have seen has a capitulum 6 mm. in vertical length and 4·5 mm. in greatest transverse diameter.

Pœcilasma eburneum is evidently a shallow-water species, although not exactly littoral. It has only once been taken by the "Investigator," so far as I can discover, but on that occasion in considerable numbers. I have not, however, been able to examine many of the Indian Echinoidea to which barnacles might be expected to be attached, the greater part of the "Investigator" collection being in the hands of a specialist abroad.

Genus MEGALASMA, Hoek (1883).

Distinguished from *Pœcilasma* by its extremely broad carina, which is expanded laterally but does not form a transverse disk at the base. Valves heavy and fully calcified, the scutum entire. Peduncle invariably short.

This genus was created by Hoek in 1883 for the reception of a single species (*M. striatum*) and has recently (1907) been much extended by Pilsbry, who has not only described several new species but has also included several others previously ascribed to *Pœcilasma*. The latter species constitute in his opinion a subgenus of *Megalasma* which he has called *Glyptelasma*; they agree with the species of *Megalasma* in the lateral expansion of their carinæ but differ in the position of the umbo of the scutum, which in the more typical forms of the genus has rotated through an angle of 90° and taken up a position in line with the occludent margin, while in the species included in Pilsbry's subgenus, as well as those left in *Pœcilasma*, the umbo is situated at some distance from the margin of the capitulum.

It is certainly very difficult to separate the species of *Glyptelasma* from those of the typical *Megalasma*. Young individuals of *M. minus*, which is as typical a form as any, sometimes approach very closely to the subgenus, resembling *Megalasma* (*Glyptelasma*) *gracile* in outlines with sufficient exactitude to deceive me as to their correct diagnosis. No true species of *Glyptelasma*, however, has been reported from Indian seas.

There is unfortunately some confusion as to the species of *Megalasma* which occur in Indian seas. In 1894 Weltner described a form to which he gave the name *Megalasma carino-dentatum*. In preparing his diagnosis he had before him a single specimen from the "Investigator" collections. The specimen was returned to the Indian Museum but was apparently overlooked when the collection of which it formed a part was unpacked. I have been unable to trace it and have little doubt that it has perished. Pilsbry has recently (1907) suggested that this specimen, which it is impossible any longer to re-examine, was an abnormal one.

A second form was described by myself in 1906 as *Megalasma striatum* subsp. *minus* and by Hoek in 1907 as *Megalasma lineatum*. Hoek, after seeing the figure of my subspecies in the "Investigator" Illustrations, acknowledged that *M. lineatum* was a synonym, and Pilsbry has recently redescribed the form, showing that it should rank as a distinct species. *M. minus* may therefore be considered a well established species, if it is distinct from *M. carino-dentatum*. The distinctive characters of the latter were its reduced terga and toothed carina. I have examined over sixty specimens of *M. minus* and have found none with a toothed carina; but the relative size of the tergum varies considerably in this series and a tooth occurs on the carina on a small proportion of individuals of some species of *Pœcilasma* (*e.g.*, *P. minutum*, see fig. 5, pl. vii).

For these reasons, in the absence of a specimen of *M. carino-dentatum*, I think it will be best to regard the species as a doubtful one.

Megalasma carino-dentatum, Weltner (*species dubia*).

M. carino-dentatum, *Weltner, Sitz. Ber. Ges. Naturf. Freunde*, 1894, p. 84.

Exhibiting the characters of the genus; the carina with a distinct tooth near its upper extremity; terga reduced.

Attached to the filamentous spicules of the Hexactinellid sponge *Hyalonema masoni*, Bay of Bengal at a great depth.

Megalasma minus, Annandale.

M. striatum *subsp.* minus, *Annandale, Ann. Mag. Nat. Hist.* (7), vol. xvii, p. 399 (1906); *Illustr. Zool. "Investigator,"* Crust. Ent., pl. i, fig. 8 (1907); M. minus, *Pilsbry, Proc. A. Nat. Sci. Philadelphia*, lix, p. 409, figs. 1, 3, 4, 6 (1907).

M. lineatum, *Hoek, Siboga-Exped.*, Mon. xxxi*a*, Cirr. Ped., p. 31, pl. iv, figs. 1—8 (1907).

Capitulum.—*Carina* reaching posterior angle of the tergum above, where it is distinctly pointed, with a regular series of Λ- shaped ridges on the dorsal surface; the lateral surfaces strongly ridged vertically, the lateral basal margin frequently irregular. *Tergum* subtriangular, the posterior angle narrowly truncate or irregularly sinuous; the occludent margin barely $\frac{1}{3}$ as long as scutal margin; scutal and superior margins equal; a distinct internal tooth near the scutal margin a short distance

from the occludent. *Scutum* not much inflated, its vertical length about six times the length of the occludent margin of the tergum; external surface bearing a single well-marked semicircular ridge, which extends from near the umbo on the occludent margin to the point where the carina, tergum and scutum meet; a strong umbonal tooth on both scuta.

PEDUNCLE relatively stout, very short.

CIRRI, etc.—First cirrus widely separated from second; its anterior ramus reaching the distal extremity of the penultimate joint of the posterior ramus; rami with eight or nine joints, slender with both margins spinose. Other cirri normal, with well-developed anterior fringes and posterior bunches of bristles; the number of bristles in each of the latter being variable. *Anal appendages* short, uniarticulate, truncated, bearing a row of short bristles at the tip. *Penis* moderately long, slender, bearing numerous fine scattered hairs on its surface and a somewhat less sparse bunch of similar hairs at the tip.

MOUTH PARTS somewhat variable, as in most species of *Pœcilasma* and *Megalasma*. *Labrum* bullate, with a row of small triangular teeth. *Maxilla* with the biting edge forming a ⟩-like outline, the excavation being deep and rounded and having its inner margin with a curved and gradual slope; three stout spines external to the excavation, several fine hairs at its base and about twelve slender spines on its inner margin and internal to it. *Mandible* with four or five teeth, the innermost tooth, when five are present, being narrow and spine-like; the greater part of the mandible covered with minute bristles arranged in small transverse rows of three or four bristles each.

This species is common in the deeper parts of the Bay of Bengal and has recently been found in the Malay Archipelago. Pilsbry has described a very similar form from the S. Pacific under the name *Pœcilasma bellum*[1] and later[2] has published an elaborate comparison between this species and *Megalasma minus*. Undoubtedly differences exist between these two forms, and I find that most, though not all, of the differences noted by Pilsbry are constant. Moreover, I owe to his kindness the opportunity of examining a specimen of *M. bellum*. I do not think, however, that the two forms should be regarded as specifically distinct, for they seem to me to be merely local races, differing from one another in minute and comparatively unimportant characters. The following table will serve to distinguish them from one another, but I should not be surprised to find that other "species" in the genus should (if my views as to what constitutes a subspecies be correct) be regarded as subspecies of *M. minus*.

Megalasma minus.

Race I (typical form).—Vertical length of scutum at least twice the greatest transverse diameter.

Race II (*Megalasma bellum*, Pilsbry).—Vertical length of scutum less than twice the greatest transverse diameter.

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[1] *Bull. Bur. Fisheries*, xxvi, p. 183, pl. iv, fig. 6 (Washington, 1907).

[2] *Proc. Acad. Nat. Sci. Philadelphia*, lix, p. 409 (1907). The first paper was written some time before publication.

There are small differences in the other valves and in the cirri, but the relative width of the scutum affords the easiest means of distinguishing between the two races.

Genus Dichelaspis, Darwin (1851).

Closely allied to *Pœcilasma*, from which its species may be recognized by the imperfect development of their valves. These are never closely approximate. Scutum never entire unless it is reduced to a mere rudiment, otherwise consisting of two distinct segments or of two or even three branches united at the base. Tergum as a rule with the scutal margin excavated to correspond with the tip of the occludent segment or branch of the scutum, often much reduced, sometimes absent. Carina simple and linear, forked at the base, or expanded into a more or less well-developed transverse disk, occasionally absent in some species.

When Darwin wrote his incomparable "Monograph" he experienced no great difficulty in separating this genus from *Pœcilasma*, although he fully realised their close relationship. Intermediate forms were not then known to exist. Several such forms have, however, now been discovered and there is no longer any morphological justification for the separation. I retain the two genera as a matter of convenience, for together they would be of a somewhat unwieldy character. As Pilsbry has recently pointed out, however, the name of those species which have imperfect valves should, if the laws of priority were strictly followed, be *Octolasmis*, for Gray described *Octolasmis warwickii* in 1825. Darwin was aware of the fact and changed the name because it was inappropriate—a course that would not nowadays be considered correct. To revive the earlier name, nevertheless, would only cause confusion, for it has long been obsolete.

The nomenclature of the Oriental species of the genus is at present in some confusion owing to the large number of names that have been given to variable species. Fortunately I have been able to examine considerable series, consisting in most cases of over a hundred specimens, of all the species known to exist in Indian seas. I have therefore been able to revise their synonymy with some confidence, although not without prolonged deliberation in each case. In spite of the large number of specimens examined, I have been forced to describe two species as new and to recognize eight already described as distinct. One of these eight has only been recorded hitherto from the North Atlantic.

Key to the Indian species of Dichelaspis.

I. Tergum large, triangular or nearly so.

A. Carina expanded into a large transverse disk at the base.

a. Two segments of the scutum close to one another. Capitulum nearly as broad as long .. .. *D. tridens.*

B. Carina neither forked at the base nor expanded into a regular disk.

b. Capitulum nearly twice as long as broad .. *D. bathynomi.*

II. Valves more or less rudimentary. Tergum much reduced.

A. Tergum[1] shaped like an axe with the shaft pointing towards the carina in a slanting direction.

a. Carinal segment of scutum triangular. Carina divided transversely near the base .. .. *D. warwickii.*

a'. Carinal branch of scutum linear. Carina entire .. *D. grayii.*

B. Tergum saddle-shaped, vertically elongate, or (occasionally) square.

b. Carinal segment of scutum triangular; occludent segment linear or almost so .. .. .. *D geryonophila.*

b'. Scutum consisting of three linear branches, one horizontal and two vertical; tergum subtriangular but vertical.. .. .. *D. rhinoceros.*

b''. Scutum consisting of two linear branches which meet one another at an angle less than a right angle; the lower branch passing above and almost parallel to the basal branch of the carina .. .. *D. sinuata.*

C. Tergum star-shaped.

c. Scutum consisting of two linear branches meeting one another at an angle, the lower branch shorter and narrower than the upper .. .. .. *D. stella.*

D. Valves much reduced. Tergum absent or represented by an amorphous chitinous patch.

d. Carina forked at its base; the basal branches directed upwards in a slanting direction .. .. *D. cor.*

d'. Carina sometimes absent, its base either simple or forked, the basal branched, when they are developed, horizontal .. .. *D. angulata.*

The different species of *Dichelaspis* differ so much from one another as regards the shape of the valves that it is not surprising that attempts have been made to divide the genus. In 1869 Macdonald described *D. neptuni* as *Paradalepas neptuni*, in a paper entitled "On an apparently new genus of minute parasitic Cirripedes" (*P.Z.S.*, 1869, p. 440), while in 1894 Stebbing introduced a new genus for the form he called *Trichelaspis forresti* (*Ann. Mag. Nat. Hist.*, xiii, p. 443). The latter was believed to be distinguished from all other species of *Dichelaspis* by the fact that it had three branches to the scutum. Gruvel, however, has since pointed out that this character is not constant even in individuals of Stebbing's species; it is even more marked in one of my new species, *D. rhinoceros*, so called from the resemblance in outline between its scutum and the top of the head and the horns of a two-horned rhinoceros. There does not seem to be any justification for the separation either of these

[1] In the var. *pernuda* of *D. grayii* the tergum is absent. This species may be recognized by the great length of the caudal appendages, which are from $\frac{1}{3}$ to $\frac{1}{2}$ as long as the sixth cirri.

species or of *D. neptuni* from the genus *Dichelaspis*. *D. neptuni* is closely related to *D. sinuata*, of which it may be a local race or even a chance variety.

Hoek, in his recent account of the Pedunculate Cirripedes of the "Siboga," divides the genus into seven sections, much on the same principles as those adopted in my key, which will serve to distinguish the Indian species not only from one another but from most other forms. There are, however, a few points that I have been obliged to leave in doubt when preparing it. They may be noted here. I put them in the form of questions as follows :—

(1) Is *D. sinuata* merely a local race of *D. lowei*, Darwin? Except as regards size (which is not a reliable specific character in the genus owing to the fact that few individuals reach the maximum dimensions they appear to be capable of attaining) the difference between these two forms lies mainly in outline, and this is not only a variable character in the softer Lepadidæ, but also one liable to be altered by bad or prolonged preservation.

(2) Is *D. sinuata* distinct from the Japanese *D. aymonini*, Lesson? So far as external characters go, I have examined intermediate specimens.

(3) Is *D. mülleri*, Coker, distinct from *D. lowei*? The two are certainly very similar, but I have not seen either.

(4) Are Stebbing's *D. hoeki* and *D. antiquæ* distinct from one another? The external differences between them are certainly smaller than those which separate the extreme forms of *D. tridens*, a species belonging to the same section of the genus.

The following table shows the geographical distribution, bathymetrical range and hosts of the Indian species of *Dichelaspis*, so far as these elements in their biology have been ascertained. It will be noted that all the species are parasitic, or at least commensal, in habits, but that the degree to which they are so varies considerably, some attaching themselves to the exterior of their host, others penetrating within its gill-chamber.

An examination of the table shows that, with one exception, the Indian representatives of the genus habitually affix themselves on settling down in life to the body of some hard-shelled crustacean. The one exception is *D. grayii* which, so far, has always been found on the skin of sea-snakes. As regards the species of *Dichelaspis* commonly found on crustacea it will be seen that at least two have been found occasionally on the shells of echinoids, and that one (*D. warwickii*) sometimes fixes itself to the shells of living molluscs, to the skin of sea-snakes and even to that of fish. As regards the crustacean hosts of the genus, there is abundant evidence that the majority of the barnacles prefer a hard-shelled decapod but are not particular as to its family. Decapods are of course by far the commonest crustaceans of a considerable size and with hard shells; it is noteworthy that I have not found a single barnacle of any genus attached to the carapace, limbs or gills of any of the soft-shelled prawns dredged by the "Investigator" or purchased in the Indian markets. Probably these decapods cast their skin

too frequently for them to be suitable hosts. Apart from soft-shelled forms, *D. warwickii* apparently affects any decapod from shallow water or the surface of the sea that it happens to meet at the critical moment in its existence at which the larva must become sedentary. It is equally common on crabs like *Doclea ovis* that hug the bottom, on crabs like *Neptunus pelagicus* that swim on the surface, and on lobsters such as *Panulirus fasciatus*. *D. angulata*, *D. sinuata*, and perhaps to a less extent *D. cor*, are also somewhat catholic in their tastes, but, so far as is known, only choose decapod hosts and are usually found on pelagic species. As they are almost invariably found in the gill-chamber of the crabs and lobsters they honour with their company, it is improbable that hosts without gill-chambers attract them. *D. bathynomi*, on the other hand, has only been found on the pleopods and uropods of the largest of known Isopods, *viz.*, *Bathynomus giganteus*—a species with a hard shell and sometimes as much as ten inches long. *D. rhinoceros* and *D. stella* have each been taken on one occasion only. It is therefore impossible to say anything as regards their choice of hosts with confidence; both were found in the gill-chambers of bottom-haunting decapods. The case of *D. geryonophila* is very remarkable. It is apparently not uncommon on the gills of a certain crab (*Geryon quinquedens*) frequently obtained from deep water off the coast of New Jersey in North America. A single individual of an allied crab (*G. affinis*) has been obtained in Indian seas, representing a species originally captured near the Azores. I have examined both this specimen and one of the American species; round the entrance to the gill-chamber of both I found the barnacle in large numbers, the Indian examples agreeing so closely with the American ones that it is impossible even to regard them as representing a specialized local race. *Dichelaspis geryonophila*, up to the present time, has, therefore, only been taken with crabs of the genus *Geryon*, and with them only in the western part of the North Atlantic and in the Laccadive Sea.

As regards the position on or in the body of their host assumed by barnacles of this genus, it is possible to divide them roughly into two categories, (1) those that attach themselves to the external surface and (2) those that penetrate into the gill-chamber. To some extent it may be said that the latter are more degenerate as regards their shell than the former. In both respects, however—that is to say, both as regards habit and as regards structure—there are intermediate stages. *D. grayii* belongs to the first category, but in its transparent integument and minute valves resembles those species which frequent the gill-chambers of crabs. *D. grayii*, however, is the most thoroughly pelagic species of the genus as yet known, and in many groups of the animal kingdom a pelagic life is associated with transparency and softness of the tissues; *Lepas tenuivalvata*, in which the shape of the tergum and scutum, so far as it is ascertainable, remains typical of the genus *Lepas*, exemplifies this fact by the transparency and lack of calcium of its shell. *D. warwickii* is generally found on the external surface of its host, but on two occasions I have found small, colourless specimens of the species in the gill-chamber. Few species vary more than this one as regards the colour of the membrane of their capitulum and the degree to which their valves are calcified. The examination of hundreds of specimens has

convinced me that the darkest and hardest individuals are usually those which are attached to crabs or lobsters from the bottom, but there are exceptions to this rule. *D. sinuata* and *D. angulata* appear to be exclusively internal commensals. Their valves are more degenerate than those of any other species and their membrane is as a rule quite transparent. *D. cor*, which is usually less transparent and has rather less degenerate valves, is most often an internal commensal also; but in one instance I found large numbers of this species attached to the posterior limbs as well as the gills of a crab. *D. bathynomi* is technically an external species, but the pleopods of *Bathynomus* are well protected by the shell which overhangs them, so that the barnacles have, so to speak, a roof over their heads. I have, however, also found a few examples of the barnacle attached to the extremity of the uropods, a much more exposed situation, and although *D. bathynomus* exhibits considerable variation as regards the extent of its valves, I have not been able to detect any difference in this respect between the individuals attached to the uropods and those fixed to the pleopods. *D. tridens*, a form allied to *D. bathynomi* and like it belonging to the section of the genus in which the valves are least degenerate, is found most commonly on the mouth parts of its host or round the external margin of the entrance to the gill-chamber. It also occurs not uncommonly on the gills. All the external specimens of this species I have examined have had the valves more opaque than those of specimens from the gills; but I cannot correlate the relative extent of the valves and membrane on the surface of the capitulum with any variation in habit. *D. geryonophila* is found both in the gill-chamber and at its external opening, clustering round the aperture at the base of the chelæ.

It is not uncommon to find more than one species on the same host. For example, *D. tridens* and *D. warwickii* are frequently found together, while I have discovered *D. angulata* and *D. sinuata* on the gills of the same crab on more than one occasion.

As regards the geographical distribution of the Indian species of *Dichelaspis* little of a definite nature can be said with confidence, for few specimens of most of them have as yet been reported by students of the Cirripedes in other countries. When the internal as well as the external characters of their decapod hosts are investigated, there can be little doubt that many specimens of the internal forms will be found to exist in museums. Almost every marine crab sold for food in the markets of Bengal harbours *D. cor* or *D. angulata* in its gill-chamber, and there is no reason to think that Bengali crabs are peculiar in this respect. Unfortunately, in these days of intense specialization, the student of the decapods frequently takes no interest in the Cirripedes. I cannot doubt that the majority of the representatives of the genus *Dichelaspis* obtained by the scientific expeditions that have visited tropical seas have never been recorded in their reports.

However this may be, one point is clear as regards the Indian species, *viz.*, that a large proportion of them have a considerable range in the northern part of the Indian Ocean, sometimes extending into the Pacific. *D. warwickii*, by far the most abundant shallow-water external form in the Bay of Bengal, extends from the Persian Gulf to the China Sea; *D. sinuata*, a common species in the gill-chamber of

shallow-water crabs, from the Gulf of Suez to Java, perhaps to Japan; *D. cor*, also common, from the East Coast of Africa to Java and Sumatra; *D. angulata* from the Persian Gulf to Java; *D. tridens* from the Bay of Bengal to the Philippines. The only Indian species as yet reported from the Atlantic is a deep-sea form, namely, *D. geryonophila*; but the shallow-water species *D. sinuata* is closely allied to *D. lowei* from Madeira and *D. mülleri* from the Atlantic Coast of North America, if it is not actually identical with them, while *D. rhinoceros* is probably the Oriental representative of the North American *D. forrestii*. *D. bathynomi* and *D. stella* have as yet only been found in Indian seas, the latter on one occasion, the former in several rather widely separated localities; the host of *D. bathynomi*, *Bathynomus giganteus*, also occurs in the Caribbean Sea, but there is no evidence that the barnacle accompanies it in its American habitat.

As regards the vertical range of the species of this genus it is clear that they may be divided roughly into two sections, one only occurring at considerable depths (about 100 fathoms and over), the other only in shallow water and on the surface; but there are several exceptions to this rule; nor does it appear to be possible in most instances to make a distinction between pelagic and littoral forms. Few species have been taken at a greater depth than 200 fathoms. In Indian seas *D. bathynomi* ranges from 180 to about 500 fathoms, while *D. geryonophila* (which has been taken at still greater depths in the Atlantic) has been obtained by the "Investigator" from a depth of between 200 and 300 fathoms in the neighbourhood of the Laccadive Islands. Probably these two forms do not occur at a depth of much less than 200 fathoms. *D. tridens* and *D. sinuata*, however, extend from the littoral zone to a depth approaching or greater than 100 fathoms; *D. stella* was taken at one of 180 fathoms and *D. rhinoceros* between 60 and 100 fathoms. The remaining species appear to be confined to shallow water and to the surface.

In his recent account of the Pedunculate Cirripedes of the "Siboga" Expedition Hoek notes that the only deep-sea species (*D. welleri*) taken by that expedition is the largest species of the genus known, having a capitulum about 12 mm. in greatest length. I have, however, examined several specimens of *D. warwickii* with a capitulum about 10 mm. long and one with it over 11 mm. long, while the smallest species of the genus with which I am acquainted are *D. stella* and *D. rhinoceros*, both from considerable depths. There can be no doubt, therefore, that the deep-sea species are not always larger than those from shallow water; but there is undoubtedly some connection between the size both of individuals and of species and their habitat; those species found within the confined space of the gill-chamber of a decapod are, for instance, always small. Even in the case of external species, however, it is rare for individuals to attain their full dimensions, probably because their host gets rid of them periodically by casting its skin; the great majority of the specimens of *D. warwickii* I have examined have been less than 5 mm. long.

The influence which the species of *Dichelaspis* exert on their hosts, if they exert any influence at all, is a point worth considering but still in need of investigation. Unfortunately the only species of the genus I have seen alive are *D. angulata*,

D. warwickii and *D. grayii*, all of which live for a considerable time after their host has been removed from the water. There is no evidence that even the internal species are detrimental to any appreciable extent to the crustacean in whose gill-chamber they live. Possibly they may even be to some slight extent beneficial in aiding respiration by the movements of their cirri and by eliminating organisms which, if not actually the producers of disease, would be out of place in the breathing apparatus of any animal; for their alimentary canal is usually crammed with diatoms, foraminifera and other protophyta and protozoa. The weight of the large numbers of external barnacles, mostly belonging to this genus, which some comparatively small decapods have to bear must be a strain upon them, and pelagic species such as those of *Neptunus* must be somewhat hampered in swimming by the tassel-like masses of *D. warwickii* adhering to their swimming legs and to the sides of their carapace. I have seen more than 600 specimens of *D. grayii* attached to a single snake, and the number of individuals of *D. warwickii* attached to a single crab is often almost as great. It is probable, however, that soon after the barnacles have attained such numbers the crab or lobster or snake casts it skin, for when such masses are present they obviously include barnacles of several generations and only a few are of full size. In the case of bottom-haunting crabs, moreover, it is by no means improbable that the barnacles aid them in concealing themselves. In the Colombo Museum there is a specimen of *Dorippe dorsipes* in which the whole of the posterior part of the carapace and the base of the posterior limbs are concealed by the masses of *D. warwickii* which cluster upon them. It is well known that the crabs of this genus frequently bear upon their back, by means of limbs apparently modified for the purpose, a gastropod operculum or some similar object to which an actinian is attached. In the case of the Colombo specimen the barnacles completely take the place of this peculiar buckler, and the crab would have probably found it impossible to hold any thin object in the usual position, had there been any necessity for it to do so.

For these reasons it is impossible to class the species of *Dichelaspis* as actual parasites.

Distribution, etc., of Indian species of Dichelaspis.

Name of Species.	Localities.	Hosts.	Bathymetric Range.
Dichelaspis tridens (Aurivillius). Syn. *D. occlusa*, Lanchester.	PACIFIC OCEAN: Philippines (*Aurivillius*). GULF OF SIAM: Kelantan and Trengannu, Malay Peninsula (*Lanchester*). STRAITS OF MALACCA: N. Sumatra (*van Kampen*). BAY OF BENGAL: Balasore Bay, Orissa coast.	DECAPOD CRUSTACEA: Mouth parts of *Thenus orientalis*; gills of *Callapa exanthematosa*; base of chelæ and entrance to gill-chambers of *Xantho scaberrimus*; on *Macrophthalmus tomentosus* (*Aurivillius*).	Littoral zone; between 91 and 112 fathoms.
Dichelaspis bathynomi, Annandale.	BAY OF BENGAL: Off Ceylon; off Pegu. ARABIAN SEA: Lat. 15° 55′ N., Long. 52° 38′ E.	ISOPOD CRUSTACEAN: Pleopods of *Bathynomus giganteus*.	195 fathoms; between 225 and 594 fathoms; 585 fathoms.
Dichelaspis warwickii (Gray).[1] Syn. *D. equina*, Lanchester.	CHINA SEA (*Darwin*). MALAY ARCHIPELAGO: Borneo (*Darwin*, *Aurivillius*); Java, Sumatra (*van Kampen*). GULF OF SIAM: Trengannu or Kelantan, Malay Peninsula (*Lanchester*). BAY OF BENGAL: Orissa, Madras, Ceylon, Chittagong, Arakan, Estuary of Ganges. ARABIAN SEA: Laccadives or Maldives (*Borradaile*); N. end of Persian Gulf.	DECAPOD CRUSTACEA: Mouth parts, limbs and carapace of *Thenus orientalis*, *Panulirus* spp., *Doclea ovis*, *Doclea japonica*, *Doclea hybrida*, *Egeria* spp., *Arcania septemspinosa*, *Neptunus gladiator*, *N. pelagicus*, *Goniosoma* spp., *Dorippe dorsipes*, etc. MOLLUSCA: Living shell of *Murex* sp., and of "mussels." REPTILIA: Skin of *Hydrus platurus*. FISH: Back of *Serranus lanceolatus*.	Littoral zone, probably not extending below 40 fathoms; pelagic.
Dichelaspis grayii, Darwin. Syn. *D. pellucida*, Darwin.	INDIAN OCEAN (*Darwin*). BAY OF BENGAL: Mergui, Arakan, Andamans, Ceylon, Madras, Orissa. ARABIAN SEA: Travancore coast.	REPTILIA (Ophidia): *Hydrus platurus*, *Distira robusta*, *D. viperina*, *Hydrophis spiralis*, *H. gracilis*, *H. fasciatus*, *Enhydrina valakadien*.	Pelagic.

[1] I have recently found small specimens of this species attached to a living Antipatharian dredged from a depth of between 24 and 30 fathoms off the Madras coast.—*June 21st*, 1909.

Distribution, etc., of Indian species of Dichelaspis—*concld.*

Name of Species.	Localities.	Hosts.	Bathymetric Range.
Dichelaspis geryonophila, Pilsbry.	N. Atlantic: Martha's Vineyard, off New Jersey, N. America. Arabian Sea: Near Laccadive Islands.	Decapod Crustacea: *Geryon quinquedens* (N. America); *Geryon affinis* (Laccadive Sea).	435—1,043 fathoms (*Pilsbry*); 328 fathoms (N. America); between 224 and 284 fathoms (Laccadive Sea).
Dichelaspis rhinoceros, sp. nov.	Bay of Bengal.	Decapod Crustacea: Gills of *Encephaloides armstrongii*.	60—100 fathoms.
Dichelaspis sinuata, Aurivillius Syn. *D. trigona*, Aurivillius. ,, *D. vaillanti*, Gruvel.	Red Sea: Suez (*Gruvel*). Persian Gulf: N. end (*Lloyd*). Bay of Bengal: Andamans. Malay Archipelago: Java (*Aurivillius*); Sumatra (*van Kampen*).	Decapod Crustacea: *Panulirus* spp., *Neptunus pelagicus* (always in gill-chambers), *Echinoplax pungens* (gills).	Littoral and pelagic; once between 130 and 250 fathoms.
Dichelaspis stella, sp. nov. ..	Bay of Bengal.	Decapod Crustacea: *Homola megalops* (gills).	180 fathoms.
Dichelaspis cor, Aurivillius. Syn. *D. maindroni*, Gruvel. ,, *D. coutierii*, Gruvel.	E. Africa: Port Natal (*Aurivillius*); Obok, Djibouti, French Somaliland (*Gruvel*). Persian Gulf: Muscat (*Gruvel*). Arabian Sea: Karachi. Bay of Bengal: Mouth of River Hughli; Salt Lakes, near Calcutta; Balasore Bay, Orissa coast; Rangoon River, Pegu; Pondicherry (*Gruvel*). Malay Archipelago: Java (*Aurivillius*); Sumatra (*Gruvel*).	Decapod Crustacea: Gills of *Panulirus* sp. (*Gruvel*) and of *Scylla serrata*.	Estuarine. ? Pelagic.
Dichelaspis angulata, Aurivillius. Syn. *D. aperta*, Aurivillius. ,, *D. cuneata*, Aurivillius. ,, *D. bullata*, Aurivillius. ,, *D. transversa*, Annandale.	Bay of Bengal: Orissa coast. Arabian Sea: Bombay (*Imms*). Persian Gulf: N. end (*Lloyd*). Malay Archipelago: Java (*Aurivillius*); Sumatra (*van Kampen*).	Decapod Crustacea: Gills of *Panulirus* spp., *Neptunus pelagicus*, *N. sanguinolentus*, *Goniosoma crucifer*.	Littoral and pelagic.

Dichelaspis tridens (Aurivillius).

Pœcilasma tridens, *Aurivillius*, "Studien über Cirripeden," *Kongl. Sv. Vet. Akad. Handl.*, xxvi, No. 7, p. 14, pl. i, fig. 13; pl vi, fig. 12; pl. viii, figs. 13, 29.

Dichelaspis occlusa, *Lanchester*, "Crustacea of the 'Skeat Expedition,'" *Proc. Zool. Soc. Lond.*, 1902 (ii), p. 373, pl. xxxv, figs. 6—6*c*.

CAPITULUM laterally compressed, oval, produced into a more or less distinct rounded projection in front of the tergum. Valves well developed, calcified, more or less opaque. *Carina* broadly, regularly curved, expanded at the base into a well-developed transverse disk, somewhat concave externally in this region, with a broad, flat, inferior margin, which is co-terminous with the lateral surface above; a low dorsal ridge generally running the whole length of the valve; the apex situated at a point about half the distance between the carinal angle and the umbo of the tergum, from the carinal margin of which the carina is often by no means widely separated. *Tergum* irregularly triangular, with two distinct excavations on its scutal margin; its breadth more than twice its greatest height; the umbo situated on or near the margin of the capitulum; the occludent margin irregularly curved, diverging from the edge of the capitulum, with which it is in contact only at the umbo. *Scutum* consisting of two segments, both approximating to the tergum above; the occludent segment sickle-shaped, with the tip at the base and the upper extremity pointed or truncated, extending considerably above the highest point of the tergal margin of the carinal segment; the carinal segment approximating closely to the occludent, with which it is sometimes in contact above, sometimes almost quadrangular, narrowly separated from the carina behind and almost in contact with the tergum above, sometimes separated from the tergum and carina by a considerable extent of membrane and nearly triangular, the tergal margin sinuate, the carinal almost straight.

PEDUNCLE as a rule short and stout, sometimes long and moderately slender, ringed or smooth, covered with minute chitinous points, which often give it a deep yellow colour.

CIRRI, etc.—First cirrus short and slender, the two branches subequal, each with six joints. The three distal joints of each bearing at their distal extremity a complete circle of long, stout bristles, the third joint from the base a similar but incomplete circle; a fringe of similar bristles on the distal half of the anterior edge of the fifth and sixth joints and the distal quarter of the anterior edge of fourth joint; the fringe on the posterior edge of both branches consisting of fine hairs. The remaining cirri slender and rather short, very widely separated from the first pair, each joint bearing, on its anterior edge, a double fringe of long, closely-set hairs, and a bunch of rather stouter hairs at the tip of the joint behind. *Anal appendages* somewhat variable in length, usually reaching the tip of the pedicel of the sixth cirrus, bearing a pencil of long hairs at the tip and on the distal half or third of the posterior edge. *Penis* long and tapering, minutely and regularly ringed, with a few short, scattered hairs, chiefly on the dorsal surface, and a bunch of longer hairs at the tip.

Mouth parts.—*Outer maxillæ* very broad, almost quadrangular, with a fringe of hairs at the extremity. Palp broadly conical, with a few fine hairs on the dorsal edge and a bunch of stouter ones at the tip. *Maxilla* with a shallow and narrow incisure on its free edge, bearing externally to the incisure three stout spines, of which the outermost is the stoutest; at the base and on the inner edge of the incisure several bristles, and internally to it about ten to twelve spines of different lengths, the first or second and the last being the stoutest; the ventral edge fringed with fine hairs. *Mandibles* normally with five teeth, the two innermost of which (inner angle) are close together, while the outermost, which is much stouter than the others, is widely separated from them; the two innermost teeth covered with fine, short hairs. *Labrum* feebly bullate, apparently without chitinous teeth.

The anatomy of this species closely resembles that of *Pœcilasma minutum* in several respects, but differs in others, notably as regards the maxillæ. The carina resembles that of *P. excavatum* and *P. dubium*. My description is not so different from Lanchester's as it might seem to be on casual inspection, but, having examined a large number of specimens from different hosts and different localities, I have been able to note a considerable amount of variation, especially as regards the development of the valves. Lanchester, in dealing with the mouth parts, has obviously called that end of the free edge I have called inner, outer, and *vice versâ*. The whole of the free edge internal to the incisure is on a higher level than the base of the incisure, which is very shallow, but also than the base of the three stout spines external to it. These spines are a feature common to a good many species both of *Pœcilasma* and of *Dichelaspis*, the two inner ones being parallel to one another—not arranged in a linear series.

At first, when dealing with the specimens of this species, I thought that they represented two distinct species or varieties; but, with the whole series before me, including a number from Sumatra which Dr. van Kampen has been kind enough to send me, I find it impossible to discover a definite break at any point. The two individuals figured represent the extreme forms that the species assumes, while the one figured by Lanchester was intermediate in some points. The exact outline of the capitulum is a variable character, and so is the appearance of the valves, which are translucent in some specimens and opaque in others. A common feature is a white vertical bar, often very indistinct, on the capitulum near the upper part of the occludent margin.

Aurivillius's *Pœcilasma tridens* was evidently a young example of the species. The length of the peduncle is a variable character, although I have only seen it quite so long in one specimen as it appears to have been in the type of *P. tridens*. Aurivillius says that the mandible has no incisure, but in my specimens the incisure is often so shallow that it may very easily be overlooked. I hesitated, however, to sink Lanchester's name as a synonym without seeing specimens from the Philippines, until I found a young specimen from the Orissa coast agreeing in every respect with Aurivillius's figures and accompanied by others resembling those of Lanchester.

D. tridens is apparently not uncommon in the seas of Sumatra and the Malay Peninsula, but it is not very often met with in Indian seas. It appears to prefer as hosts crustacea such as *Thenus orientalis* which habitually live in rather shallow water but are also found at a depth of between 100 and 200 fathoms. As a rule it clusters on the mouth parts of its host and round the entrance to the gill-chambers or the base of the chelæ. Occasionally, however, it also adheres to the gills themselves and the membrane that covers them above.

Like most species of its habits, *D. tridens* is small. In large adults containing eggs the capitulum measures about $3{\cdot}5 \times 2{\cdot}5$ mm., and the peduncle is usually shorter than the capitulum. As a rule young individuals have the capitulum relatively narrower and the peduncle longer and more slender. I have found eggs, however, in the shells of individuals which had these characters. The peduncle varies considerably in length even in the larger specimens, and is smooth in some, annulated in others; the development of the chitinous points with which it is beset is also a variable character; for in some large individuals they are minute, colourless and almost invisible, while in others they are much larger and have a deep yellow colour.

Dichelaspis bathynomi, Annandale.

D. bathynomi, *Annandale, Ann. Mag. Nat. Hist.* (7), vol. xviii, p. 45 (1906); *Illustr. Zool. "Investigator,"* Crust. Ent., pl. v, fig. 1.

CAPITULUM regularly and somewhat narrowly ovoid, pointed above, rounded at the base, compressed, covered by the valves to a variable extent; the outlines of the five primitive valves and their lines of growth always distinct; the calcified valves more or less hyaline, with an opaque area at the umbo. *Dorsum* large, subtriangular; its umbo situated close to the carinal margin of the capitulum, its superior margin more or less curved and forming a continuous line with the carinal margin; rostral and carinal angles acute; the scutal margin almost straight or excavated to correspond with the tip of the occludent segment of the scutum. *Scutum* in two segments, which diverge above to a variable extent; the occludent segment rounded or truncate at the apex (at which point it is in contact with the dorsum), pointed at the base, regularly arched; carinal segment variable in outline and extent, subtriangular or triangular, not reaching so high above as the occludent segment. *Carina* rather short, of variable lateral width, with more or less defined lateral ridges, expanding at the base into a transverse disk, which is much smaller than that of the carina of *D. tridens*.

PEDUNCLE fairly slender, cylindrical, of variable length, covered with small, chitinous tubercles which vary in size and colour.

CIRRI, etc.—First pair of cirri somewhat widely separated from second, resembling those of *D. tridens*, to which the species is closely related as regards its anatomy generally. *Anal appendages* uniarticulate, rather slender, bluntly pointed, bearing a short fringe of long bristles on the posterior margin of the extremity only. *Penis* of variable length, slender, pointed, covered with closely set rings of minute

chitinous teeth and bearing a bunch of soft, delicate processes at the tip; one of these processes sometimes longer than the others.

Mouth parts.—*Labrum* bullate, bearing a row of small conical teeth, which increase gradually in size from within outwards; at the outermost rim of the circle the row is double for about five teeth. Palpi short, conical, bearing long hairs on the dorsal surface. *Maxilla* with a deep and rather narrow excavation, the inner edge of which bears two or three stout hairs; three very long and stout external bristles, one of which is almost a tooth; the inner bristles short and fine, generally subequal. *Mandible* with five teeth; its inner arm narrow and elongated.

In large specimens the length of the capitulum is from 6 to 8 mm.

Two varieties of this very variable species may be distinguished as follows. Intermediate forms occur, however, although the gradation is slightly abrupt:—

Var. I (typical form)—

Carinal margin of the scutum widely separated from the carina, towards which it is concave. Carina laterally narrow.

Var. II (*perfidiosa*, nov.)—

Carinal margin of scutum in contact with the carina for a considerable part of its length, convex towards the carina. Carina much broader laterally than in the typical form.

I was at first inclined to regard these two forms as distinct species, although they were found together; but on comparing adult specimens of both I became convinced that they were only varieties. There does not seem to be any constant anatomical difference between them, although both are very variable as regards the cirri, penis, etc.

Dichelaspis bathynomi has only been found in association with the deep-sea Isopod *Bathynomus giganteus*, on the pleopods of which it is always, so far as my experience goes, abundant. There are large numbers of Decapod crustacea in the Museum collections from the same parts of the Bay of Bengal and the Arabian Sea as those in which *Bathynomus* has been taken, but I have been unable to find on them a single example of *D. bathynomi*.

Dichelaspis warwickii (Gray).

D. warwickii, *Darwin*, *Mon. Cirr.*, Lep., p. 120, pl. ii, figs. 6, 6a, 6b; *C. W. Aurivillius*, "*Stud. ü. Cirr.*," *Kongl. Sv. Vet. Akad. Handl.*, xxvi, No. 7, p. 15, pl. viii, figs. 26, 27.

D. equina, *Lanchester*, *Proc. Zool. Soc. Lond.*, 1902 (ii), p. 385, pl. xxxv, figs. 7, 7a—d; *Annandale*, in *Herdman's Pearl Oyster Fisheries* (Roy. Soc.), part v, p. 139, fig. 2; *Illustr. Zool.* "*Investigator*," Crust. Ent., pl. v, figs. 4—6.

Capitulum irregularly ovoid, the occludent margin being nearly straight and vertical, the carinal margin broadly arched; the apex rounded or bluntly pointed; the membrane translucent or opaque, often very thick, white or orange-colour, occasionally

deep purple in very large specimens, often with the outlines of the five primitive valves well marked upon it; the calcified valves covering about half the surface but widely separated from one another, more or less fully calcified, translucent or opaque. *Tergum* shaped like an axe or a horse's head and neck, the handle of the axe (or neck of the horse) stout, slanting downwards towards the scutal margin of the carina, which it does not nearly reach; a considerable vertical depression usually present on the anterior part of the valve. *Carina* extending upwards far above the carinal angle of the tergum, usually rather broad, with a broad irregular dorsal ridge on the basal third or quarter, split transversely into two plates (the upper of which is devoid of a special centre of calcification) through this ridge; the basal branch well-developed, running parallel to and below the basal margin of the scutum, deeply buried, terminating in a large, broad, oval, flat transverse disk, the lateral margins of which usually bear conspicuous ridges; the edge of the disk more or less notched and irregular, as the whole margin of the lower part of the valve also frequently is. *Scutum* with two branches or segments, the separation being incomplete in some specimens; the occludent margin nearly straight, cone-shaped, slanting outwards from above, its apex separated from the scutal margin of the tergum but corresponding with the deep excavation therein; carinal segment much shorter than the occludent subtriangular, the upper angle usually being rounded and the carinal margin more or less concave.

PEDUNCLE cylindrical or compressed, usually smooth, tapering towards the base, moderately stout, naked or with minute chitinous points.

CIRRI, etc.—First pair of cirri, in the natural position, not far removed from second, but remote if the animal be stretched out, from $\frac{1}{2}$ to $\frac{2}{3}$ as long; the anterior ramus slightly shorter than the posterior, but of the same width; each ramus with six distinct joints, which are subrectangular towards the base and oval near the apex; each joint well encircled by bristles. Second cirrus with the anterior ramus slightly shorter than the posterior, its bristles (as those of the cirri posterior to it) well developed but more slender than those on the first cirrus; the anterior margin of the segments distinctly convex, while in the third to sixth cirri it is almost straight, projecting outwards at the apex of the segment and slanting in towards the base. The cirri as a whole rather feebly curved. *Anal appendages* slender, rounded at the tip (which usually bears a bunch of long hairs), very variable in length, curving outwards from the base. *Penis* of moderate length, rather slender, tapering, covered with scattered hairs and more or less distinctly annulated, bearing at the tip a bunch of less sparse hairs and a delicate process, which is apparently retractile.

MOUTH PARTS.—*Labrum* bullate, with a row of comparatively large teeth. Palp short and stout, with long hairs at the tip. *Mandible* with four or five teeth, the fifth being small and blunt when present. *Maxilla* with a deep incisure, closely resembling the maxilla of *D. bathynomi*.

The capitulum occasionally reaches a length of at least 11·5 mm.

This is another variable species, probably recognized as such only owing to the fact that large numbers of specimens have been examined. It is by far the commonest

Pedunculate (except perhaps *Lepas anserifera*) in the shallow parts of the Indian seas, and hundreds of specimens have passed through my hands; there are certainly at least 1,000 in the Museum collection. Curiously enough, the one character I find constant has caused confusion as regards the species, *viz.*, the separation of the carina into two parts by a transverse fissure near the base. Neither Gray nor Darwin recorded this character, which is by no means clear in shrunken specimens; but Aurivillius noted it in specimens from the China Sea as well as from the Malay Archipelago. Dr. W. T. Calman of the British Museum has kindly sent me the following note :—"All our specimens labelled *Dichelaspis warwickii* have the carina divided horizontally as in the specimens of *D. equina* which you send. They are unfortunately far from numerous and they do not appear to include Gray's types (unless these are among some old specimens of which the localities have been lost), but they do include one tablet with half a dozen dry specimens labelled *D. warwickii*, var. in Darwin's handwriting." The transverse fission of the carina is a varietal character in *Dichelaspis geryonophila*, and it is of course possible that a race or variety of *D. warwickii* may occur in which it is absent. If this be so, this race or variety would be the typical form, while the common Indian form would become "subsp." or "var *equina*."

Dichelaspis geryonophila (Pilsbry).

Octolasmis geryonophila, *Pilsbry*, *Bull. U. S. Nat. Museum*, No. 60, p. 94, figs. 32*a*, *b* (1907).

Capitulum ovoid or triangular, variable in relative transverse diameter, laterally compressed, bearing five widely separated valves and usually marked on the surface with fine serrated ridges representing more or less completely the five primitive valves and their lines of growth. Membrane more or less opaque, colourless or tinged with orange. *Carina* forked at the base, the length of the basal branches being variable; the vertical branch moderately broad, often of irregular outline, reaching above the level of the base of the tergum; dorsal surface with a rounded ridge on the lower part, inner surface with a deep pit near the base. *Tergum* small, irregularly saddle-shaped, often having the outline of a bird's head with the beak pointing to the aperture. *Scutum* consisting of two branches or segments sloping towards one another; the lower branch triangular, shorter and usually broader than the upper, which is sharply pointed above and directed towards the concavity in the tergum, from which it is often widely separated.

Peduncle naked, often longer than the capitulum, broader at the base than above, irregularly annulated.

Cirri, etc.—First cirrus slender and rather short, its anterior ramus similar to the posterior one but shorter by about half the length of the distal joint of the latter; the distal joint of each ramus bearing near its tip a circle of stiff, sharply pointed spines and terminating in a bunch of fine hairs: all the joints densely fringed anteriorly. Other cirri widely separated from the first, rather short, slender, pointed, densely fringed. *Anal appendages* not quite reaching the junction of the two branches

of the sixth cirri, slender, slightly spatulate, rounded at the tip, which bears a pencil of stout hairs, some of which are considerably longer than the appendage itself: the upper third of the posterior edge bearing similar hairs. *Penis* slender, abruptly pointed at the tip, moderately long, clothed with closely set rings of minute spines and bearing a few scattered hairs.

MOUTH PARTS.—*Labrum* broad, bearing a row of short, rather stout teeth. Palpi short, slender, bearing a pencil of long hairs at the tip. *Outer maxillæ* broadly oval, densely fringed. *Maxillæ* with a broad, rather shallow, pointed incisure near the outer edge, which is armed with a long, slender spine; between this and the incisure two or three more slender spines of varying length; a long slender spine immediately on the other side of the incisure followed by several others (usually six) of varying lengths; the inner edge of the appendage irregularly serrated and bearing a fringe of fine hairs. *Mandibles* bearing five teeth, the outermost of which is by far the largest and is separated widely from the rest; the fourth tooth short and often blunt, the fifth slender and rather long; the four inner teeth and the part of the appendage adjacent to them clothed with minute spines; the inner edge of the appendage bearing a fringe of fine hairs.

I have examined some twenty specimens of this species from the entrance to the gill-chambers of two deep-sea crabs.

Specimens.

$\frac{5}{1}\frac{6}{0}\frac{3}{0}\frac{7}{}$ Gill-chambers of *Geryon affinis*. Stat. 248 (Lat. 8° 37′ N., Long. 75° 37′ 30″ E., Laccadive Sea), between 224 and 284 fathoms. (S.S. "Investigator.")

$\frac{5}{1}\frac{6}{0}\frac{3}{0}\frac{8}{}$ Gill-chambers of *Geryon quinquedens*. "Martha's Vineyard" (off coast of New Jersey, U. S. A.), 328 fathoms. (Smithsonian Institution.)

Remarks—

This species is variable as regards the exact form of its valves, the colour of the membrane, the relative lengths of the capitulum and peduncle, and the proportions of the latter. The lower branch of the scutum is sometimes broadly triangular, occasionally almost linear, the outline of the tergum differs greatly in different individuals and the carina sometimes ends practically at its lowest point and is sometimes produced into horizontal branches, which may underly the extremity of the basal branches of the scutum. The specimens from *Geryon quinquedens* have a deep orange colour and are very opaque, while those from *G. affinis* are colourless and much more translucent. In all, the valves are yellowish and apparently contain a large proportion of chitin. Speaking generally, I may say that both the peduncle and the capitulum are more slender in older than in young individuals, in which the former is often somewhat narrowly oval, while in older (or at any rate larger) examples it is broadly triangular. Even the narrow, oval individuals, however, often bear ova. There is one character shown by some individuals among those from *Geryon quinquedens* (*viz.*, the transverse fission of the carina) which seems to justify them being considered a distinct variety, for which the name var. *fissicarina* is proposed.

The above description and notes were drawn up before I realized that I was dealing with specimens both from the Atlantic and from the Indian Ocean, or that the species had already been described ; for it was only on looking up the localities of the crabs in the Museum register and referring to Pilsbry's paper on the Cirripedes of the U. S. National Museum that I discovered these facts. On doing so I re-examined the specimens with the greatest care, to see whether I had overlooked any difference between the two races, and also dissected two more specimens from each lot with the same end in view. One character made it easy to distinguish the individuals found on the American crab (*Geryon quiquedens*) from those on its Indian ally *G. affinis*, namely, their colour; for the former were tinged with orange, the latter white. In itself this is not an important matter, for if two lots of specimens of the common oriental species *Dichelaspis warwickii* from different crabs from the same locality be examined, they will often be found to differ in colour. The appendages, penis and mouth parts of the two lots of specimens of *D. geryonophila* agree closely. I cannot, therefore, separate the one from the other.

The occurrence of any species of the genus on allied species of crabs so widely separated in habitat is an extremely interesting fact, and, so far as I am aware, as yet one without parallel. The American specimens in this Museum are from the same locality as those on which the species was founded. Regarding it its author says, "It is an abundant species, only known from the gill cavity of the crab *Geryon quinquedens*, and taken only in a rather small area off the continental slope east of New Jersey, in 435 to 1,043 fathoms." So far as I am aware, only one specimen of *Geryon affinis* is known from Indian seas,[1] and I am pretty sure that this is the only crab in our collection to which the barnacle is attached.

Dichelaspis grayii, Darwin.

D. grayii, *Darwin, Mon. Cirr.*, Lep., p. 123, pl. ii, fig. 9 (1851).

D. pellucida, *Darwin, op. cit.*, p. 125, pl. ii, fig. 7 ; *Hoek, Journ. Linn. Soc. London*, xxi (Anderson's "Fauna of Mergui"), p. 154, pl. xiii (1889) ; *Annandale* in *Herdman's Report on the Ceylon Pearl Fisheries* (Roy. Soc., London), pt. v, p. 140, figs. 1, 1*a*, 1*b* (1906) ; *Illustr. Zool. "Investigator,"* Crust. Ent., pl. iv, figs. 2, 3 (1908).

All the tissues very transparent [2] ; no cuticular plates or spines on the surface.

Capitulum bonnet-shaped, compressed; the carinal margin irregularly curved, the basal half being much more boldly arched than the upper half ; the occludent margin sinuous. Five narrow, widely separated valves, which vary considerably as

[1] This crab was originally taken by the "Hirondelle" Expedition off the Azores and was described by Milne Edwards and Bouvier in their account of the Decapod crustacea of that expedition. Thanks to the kindness of Prof. Bouvier and H. S. H. the Prince of Monaco, I have been able to examine barnacles attached to Atlantic specimens. They were all specimens of *Pœcilasma kæmpferi* subsp. *aurantia*.

[2] In life they have a pale vinous tint, which varies in intensity in individuals living in the same snake and disappears very rapidly on spirit or formalin.

regards the amount of calcium salts they contain, present in the typical form. *Carina* linear, arched (often irregularly), elbowed at the base but not forked, the basal branch running parallel to and some little distance below the basal branch of the scutum. *Scutum* consisting of two narrow branches which meet one another practically at a right angle; the vertical branch broader and longer than the basal one, diverging somewhat from the occludent margin of the capitulum above, pointed apically. *Tergum* shaped like an axe with a somewhat slender handle, somewhat variable in exact outline, very widely separated from the carina.

PEDUNCLE as a rule longer than the capitulum, cylindrical, slender, very soft.

CIRRI, etc.—Cirri rather short, not strongly curved; pedicels long, in the second pair equalling about one-fourth the length of the rami, which are practically equal. The posterior cirri armed with a double row of moderately strong bristles down the anterior margin and with small bunches of delicate, short hairs at the distal end of the last four or five joints posteriorly. First cirrus with the two rami subequal; the distal joint in each bearing two circles of stout bristles and all the other joints bearing several somewhat irregular circles of similar but slighter bristles. *Anal appendages* very long and slender, one-third to half as long as the sixth cirri, without joints or with five or six more or less perfectly differentiated, ending in a bunch of short hairs of different lengths and with a few scattered hairs on the posterior margin. *Penis* short and stout, minutely ringed with circles of very minute chitinous processes, pointed, somewhat curved at the tip, bearing scattered hairs all over and sometimes a long flagellum on the dorsal surface.

MOUTH PARTS.—*Labrum* more or less bullate, armed above with a row of fine, minutely pointed teeth. Palpi blunt, sparsely hairy. *Outer maxilla* broadly and regularly oval (except as regards the base), covered with scattered hairs externally. *Maxilla* deeply excavated; three long stout bristles external to the excavation; the edge internal to it somewhat sinuous, bearing several short stout bristles and some smaller ones of different sizes; a single slender bristle as a rule present at the base of the excavation; the body of the mandible covered with short hairs, most of which are arranged in pairs transversely. *Mandible* narrow, with five teeth; the innermost very small and close to the fourth; the base of the large outer tooth bearing a few scattered hairs; the inner arm, which bears the four inner teeth, covered with hairs arranged as on the maxilla.

Large specimens measure about 5 mm. in capitular length.

FIG. 8.—*Dichelaspis grayii* var. *pernuda*, × 8.

Var. *pernuda*, nov.

Valves completely or almost absent; no trace of the tergum; the scutum, if present, represented only by the vertical branch, which is devoid of calcareous salts and barely even chitinized; the carina absent. The original five valves of the Lepadidæ are sometimes represented in outline on the capitulum with their lines of growth.

Dichelaspis grayii is common on the sea-snakes of Indian seas and I have been able to examine over 800 specimens in all. This series exhibits every gradation between the typical form and *D. pellucida*, of which Darwin said, "I should not be much surprised if the present form were to turn out to be a mere variety" [of *D. grayii*].

The variety described above as var. *pernuda* is, however, a most remarkable form. I have found it in considerable numbers on three sea-snakes from different localities, always by itself so far as other cirripedes were concerned. A careful comparison of cirri, mouth parts, etc., with those of specimens of the typical form of the species shows no constant difference, while Darwin's description of these organs fits more exactly to one specimen of the variety than to any individual of the typical form I have dissected. The long anal appendages, which in some specimens of the typical form are distinctly segmented, are particularly characteristic of the

Fig. 9.—Mandible and maxilla of *D. grayii* var. *pernuda*, × 240.

species, although their exact relative length is variable, while the arrangement of the armature and ornamentation of the mouth parts also affords a sufficient means of diagnosis.

The new variety affords another link between three subfamilies of the Lepadidæ (*i.e.*, the Lepadinæ, the Pœcilasmatinæ and the Alepadinæ). The nakedness of the capitulum and its lack of a muscular layer may be only an adaptive resemblance to the genus *Alepas*, from which the well-developed cirri at once distinguish it. The absence of a muscular layer and of lateral appendages separates it from *Heteralepas*, to which, however, it exhibits a certain resemblance as regards the anal appendages and mouth parts. Both the variety and the typical form of the species, moreover, differ as regards these structures from most other species of *Dichelaspis*; but it is impossible to separate them from that genus.

Dichelaspis stella, sp. nov.

Minute, transparent, the valves occupying a small part of the area of the capitulum.

CAPITULUM laterally compressed, with the occludent margin almost straight and vertical and the carinal margin strongly arched; with four delicate, brittle valves; a considerable area of apparently reticulate structure surrounding the umbo of each valve. *Carina* linear, arched, extending more than half way up the capitulum, forked at the base, the two branches of which are variable in length, widely separated, almost parallel to one another and, in another plane, to the basal branch of the scutum. *Tergum* small, in the shape of a four-rayed star, the uppermost ray of which is usually shorter than the other three, while the lowest is longer. *Scutum* consisting of two sublinear branches which almost form a right angle, one being horizontal, the other vertical; the vertical branch considerably longer and broader than the other.

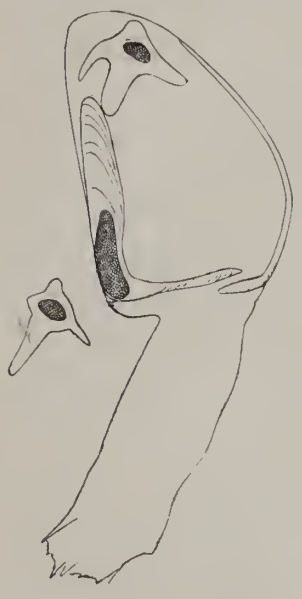


FIG. 10.—*D. stella*, × *c.* 27, with the tergum of a second specimen.

PEDUNCLE naked, generally longer than the capitulum, smooth, slender, very transparent.

CIRRI, etc.—First cirrus narrowly separated from second, with both rami slender; the anterior ramus slightly broader than the posterior, and shorter by one joint; the distal joint of each bearing at its tip a circle of long, stout spines. Remaining cirri long and slender, bearing numerous very long, slender hairs on the anterior margin of each joint and at the tip of the distal joint. *Anal appendages* short, slender, barely reaching the distal end of the basal joint of the sixth cirrus, bearing at their tip a bunch of long, fine hairs, some of which are several times as long as the appendage; the posterior margin entirely bare. *Penis* long and slender, apparently naked.

MOUTH PARTS.—*Labrum* not bullate, with a row of minute, triangular, equal teeth round its dorsal margin. Palp short, somewhat claw-shaped, bearing a fine pencil of long hairs at its tip. *Outer maxilla* short and broad. *Maxilla* with a somewhat narrow and shallow incisure about the middle of its biting edge; external to the incisure three stout spines, of which the outermost is the stoutest; internal to it about half-a-dozen more.

This is a very small species, the capitulum in all that I have seen being less than 2 mm. in length. There is only one set of specimens in the Museum, however, and it consists only of ten individuals, all of which were found on the gills of a single crab. Possibly they are immature, for none of them contain eggs. The species is evidently rare.

Dichelaspis rhinoceros, sp. nov.

Minute, transparent, with five translucent, brittle valves; the scutum with three branches; the membrane thin.

Capitulum broadly ovate, compressed; the upper part of the occludent margin more or less lobate; the base rounded. *Carina* moderately narrow, concave internally, arched, expanded at the base into a short oval disk, which is imbedded in the membrane and lies parallel to the base of the capitulum; the lateral faces at the base concave, with a distinct ridge above on the sides of the inner margin. *Tergum* relatively large, subtriangular, almost vertical, the umbo facing the dorsal edge of the capitulum; the carinal margin curved, the scutal margin with two deep, broad excavations, of which the one corresponding to the occludent segment of the scutum is the narrower. *Scutum* with a basal transverse branch from which two vertical branches arise close together; the occludent branch usually narrower and longer than the carinal one; both vertical branches widely separated from the carina, their bases curved, *not* angular; the basal transverse branch extending almost to the carinal margin of the capitulum and overlapping the basal disk of the carina at either side.

Fig 11.—*D. rhinoceros*, × 23.

Peduncle usually short, bearing rings of very minute chitinous plates.

Cirri, etc.—Posterior cirri slender, moderately short, not much curved; the bristles on their anterior margin slender but stiff, definitely arranged in a double vertical row, consisting of from five to eight pairs of bristles on each segment; the posterior terminal bunches of bristles well developed even on the proximal joints of the rami. First pair of cirri not widely separated from the others, at least three-quarters as long as the second, slender, with long pedicels; the rami subequal. *Anal appendages* long and slender, reaching considerably beyond the distal end of the pedicel of the sixth cirri, narrowly rounded at the tip, bearing a row of long bristles, some of which are longer than the appendage, on the external end of the posterior margin and the tip. *Penis* moderately long, slender, pointed, not distinctly annulated.

Mouth parts.—*Labrum* bullate. Palpi broadly conical, large, bearing a few short bristles at the tip. *Outer maxilla* broadly oval, almost truncate; its external surface covered with long delicate bristles. *Maxilla* with a deep but narrow excavation. *Mandible* small, the outer tooth not very large or very widely separated from the others, which are small and usually number four including the inner angle.

A very small species, the capitulum of adults which contain eggs measuring only about 2 mm. in length.

This species was found on the gills of several specimens of the crab *Encephaloides armstrongii* dredged in the Bay of Bengal at a depth of between 65 and 93 fathoms. It does not appear to be a common species. The shape of the scutum, with its three branches, resembles that of *D. forrestii* (Stebbing) from the Coast of Florida and the West Indies. Apart from anatomical differences, however, the tergum occupies a much greater part of the surface of the capitulum in the Indian than in the Atlantic species.

Dichelaspis cor, Aurivillius.

D. cor, *Aurivillius*, "Stud. ü. Cirr," *Kongl. Sv. Vet. Akad. Handl.*, xxvi, No. 7, p. 20, figs. 1, 2 (1894).

D. maindroni, *Gruvel*, *Mono. Arch Mus. Paris* (4), iv, p. 282, pl. iv, figs. 21—27, pl. i, figs. 15, 16 (1902).

D. coutierei, *id.*, *ibid.*, p. 289, pl. iv, figs. 28—32; *Annandale*, *Illustr. Zool. "Investigator,"* Crust. Ent., pl. iv, figs. 4, 5 (1908).

CAPITULUM heart-shaped, pointed above, gradually rounded at the base, with or without the lines of growth marked on the surface, transparent or translucent; the surface often covered with minute, chitinous points; the membrane thick. Valves three, sometimes five, narrow but stout. No definite *tergum*, which is sometimes represented, however, by an amorphous chitinous plate. *Carina* narrow, usually curved, with transverse basal branches, which are turned upwards towards the scutum; the inner part of the lateral faces usually concave. *Scutum* with two branches or segments, which are sometimes quite distinct from one another; the occludent branch or segment narrow, close to the occludent margin of the capitulum, sometimes expanded and truncated at the tip, sometimes pointed, extending along the occludent margin of the capitulum for the greater part of the length of the latter; basal branch or segment slanting inwards and upwards, narrow and pointed or expanded at the tip and truncated, its base more or less triangular.

PEDUNCLE usually longer than the capitulum, with or without chitinous points, not or barely annulated.

CIRRI, etc.—First pair of cirri close to the second or separated from it, very short as a rule, but variable in this respect. All the cirri stout and rather short. The rami of the first pair subequal, rather broad, barely longer than the pedicel, the joints profusely covered with stout hairs. The posterior bunches of hairs well developed on the posterior cirri. *Anal appendages* variable in length and armature, laterally compressed, rounded at the apex, bearing a dense apical fringe of hairs, which extends down the posterior margin to a different degree in different individuals. *Penis* usually very stout, pointed, with the apex retroverted. In some individuals, however, which are perhaps immature, it is slender, and straight at the extremity.

MOUTH PARTS.—*Labrum* prominent but not bullate, without a row of chitinous teeth above but minutely ornamented with chitinous points in some individuals. Palp rather stout, bluntly pointed, bearing on the dorsal surface at the tip a fringe of stout hairs and along the whole of the dorsal margin a more sparse fringe of similar hairs. *Mandible* with five or six teeth (including the inner angle); all the teeth short and proportionately broad at the base; the first not much larger than and by no means widely separated from the second; the second, third, fourth and fifth subequal; the extra teeth, when present, smaller than the others, situated at the base of the fifth; a small projection also present at the base of the fourth; the greater part of the mandible covered with short, fine hairs. *Maxilla* without a definite excavation although there is sometimes a very faint concavity between the first three

outer spines, which are unusually stout, and the inner ones; these latter also very stout, numbering about six, arranged in a double row with fine hairs interspersed.

Exceptionally large specimens have a capitulum about 4 mm. long, but it is more commonly from 2 to 3 mm. long even in individuals bearing eggs. A common species on *Scylla serrata* in Indian estuaries.

Gruvel separates his *Dichelaspis maindroni* from *D. cor* on the following characters :—(1) difference in shape of the upper part of the capitulum, (2) absence of any trace of the terga, (3) absence of lines on the external surface of the capitulum, (4) small differences in the cirri, mouth parts and anal appendages. The first of these is not only a variable character but one peculiarly liable to be obscured by different methods of preservation; the second is a character not constant either in this species or in others allied to it; the same remark applies to the third, while those included under the fourth heading are discussed so briefly by Aurivillius in his original description of *D. cor* that it is not possible to make a detailed comparison. I can only say that I have found the cirri, etc., extremely variable even among individuals resembling one another externally. The parallel lines on the external surface of the capitulum in some individuals clearly represent the outlines of the original five valves, in others they are confined to the upper part of the capitulum, in others they can just be traced at a few points, while in others they are quite absent.

Gruvel distinguished three varieties, which, for very sound reasons, he refused to recognize as distinct species. They are characterized as follows :—

Var. A has the extremity of the basal branch of the scutum truncate and expanded and the occludent branch considerably broader in the middle than at the base. The extremity of the basal branch of the carina is also expanded and truncate.

Var. B has the same features to a less strongly marked extent, except that the occludent branch of the scutum is barely broader in the middle than at the base.

Var. C has all the valves linear, without expansions at the extremity of any.

The three varieties occur in the Bay of Bengal, but var. A is commoner than the others and is often the only one found on the gills of a crab, although the three, with intermediate stages, sometimes occur together. The degree to which chitinous points are developed on the external surface of the capitulum and peduncle is very variable.

By the kindness of Professor Bouvier I have been able to examine co-types of Gruvel's three varieties. Too much stress must not be laid on the differences between them, for many intermediate forms occur. Also by the kindness of the same zoologist, I have received co-types of Gruvel's *D. coutierei*, which I had long suspected to be a variety of *D. maindroni* founded on specimens in which the penis was not fully developed. An examination of the co-types confirms me in this view, for they all appear to be immature. The parallel and transverse chitinous bars on the capitulum are not so conspicuous in any of the specimens I have seen as they appear to be in Gruvel's

figure but exist as slightly raised linear ridges marking the limits of the original five valves. I would therefore regard the form at most as a variety of *D. cor*.

Dichelaspis sinuata, Aurivillius.

D. sinuata, *Aurivillius, op. cit.*, p. 17, figs. 2—5.
D. trigona, *id., ibid.*, p. 19, pl. ii, fig. 8.
D. vaillantii, *Gruvel, op. cit.*, p. 279, pl. xiv, figs. 5—13; *Annandale, Illustr. Zool. "Investigator,"* Crust. Ent., pl. iv, fig. 6.

Small, more or less transparent; the scuta and carina linear; a pair of calcified terga present; chitinous points absent on the external surface, or very minute.

CAPITULUM somewhat variable in shape, more or less globose, usually having a distinct lobe on the upper extremity of the occludent margin; both edges arched. *Tergum* small, saddle-shaped or vertically elongate, occasionally almost square, fully calcified. *Scutum* imperfectly calcified as a rule, consisting of two more or less elongated, slender branches, which meet together at a point considerably removed from the base of the capitulum (in well-preserved specimens), the basal branch being nearly transverse and the occludent branch sloping towards it in such a way that the resultant angle would be less than a right angle if it were not rounded off; the two branches equal or nearly equal in length, pointed at the tip. *Carina* sometimes reduced to a mere rudiment of a narrowly triangular outline and only occupying a very small part of the dorsal border of the capitulum, more commonly longer and produced at the base into a pair of branches, which are long and slender in some individuals and barely represented even by minute rudiments in others.

PEDUNCLE generally longer than the capitulum, but sometimes much shorter.

CIRRI, etc.—Cirri short, slender and by no means strongly curved. The first pair not so widely separated from the second as in some species, very short, subequal, without stout spines, but profusely covered with delicate hairs. *Anal appendages* slender, reaching beyond the apex of the pedicel of the sixth cirri, compressed, rounded at the tip, which bears a double row of some five to seven moderately long hairs; these extend a short distance down the posterior margin. *Penis* slender, not very long, the tip very fine, ending in a bunch of fine hairs, not retroverted.

MOUTH PARTS.—*Labrum* more or less bullate, with about twelve minute, round, blunt teeth on the upper surface. Palp conical, bluntly pointed, long, covered with fine hairs and bearing six or seven irregularly placed pairs of stout bristles on and near the tip. *Outer maxilla* broad, almost heart-shaped, with a fringe of fairly stout hairs on the dorsal surface. *Maxilla* without or with a very faint incisure; the bristles not so stout as in *D. cor* and showing greater differences in size. *Mandible* with five teeth in addition to the inner angle, but with the inner angle either blunt or divided up more or less regularly into two smaller teeth; the fifth tooth small and blunt; none of the teeth very long; the first by no means widely separated from the others.

The capitulum of the largest specimens measures less than 3 mm. in length.

The series in the Indian Museum, which is a large one (including specimens from the Persian Gulf, the Bay of Bengal and the seas of Sumatra and Java) exhibits every gradation, so far as external characters are concerned, between the three forms I have regarded as synonymous. Many of the Malayan specimens, moreover, agree closely with Gruvel's description of *D. vaillanti*. The nature of the variation exhibited within the limits of the species as a whole is precisely similar to that exhibited by *D. angulata*, of which I have examined an even larger series. I propose to discuss the question at considerable length in connection with the latter species, and it is unnecessary to do so twice over.

Dichelaspis angulata, Aurivillius.

D. angulata, *Aurivillius*, *op. cit.*, p. 22, pl. ii, figs. 9—11, pl. viii, figs. 15, 24 (1894).
D. aperta, *id.*, *ibid.*, p. 24, pl. i, figs. 14—16.
D. cuneata, *id.*, *ibid.*, p. 25, pl. i, figs. 17—19.
D. bullata, *id.*, *ibid.*, p. 26, pl. ii, figs. 12, 13; pl. vi, figs. 10, 11; pl. viii, figs. 19, 25.
D. transversa, *Annandale*, *Ann. Mag. Nat. Hist.* (7), vol. xviii, p. 44, figs. 1, 1a.

Minute, more or less transparent, colourless; all the valves linear; no tergum; the external surface naked or covered with small chitinous points.

Capitulum rounded, more or less bullate, with prominent lobes above the aperture, which is sometimes transverse. *Tergum* absent as a calcified plate, but often represented by an amorphous chitinous patch, which is sometimes conspicuous owing to its yellow colour. *Carina* sometimes absent, when present of variable size and shape, often quite rudimentary, sometimes forked at the base; the basal branches never stout and never turned upwards. *Scutum* very variable, sometimes fully calcified, forming a crescentic bar, often sinuous, occasionally angular, the lower extremity sometimes produced into a fine, imperfectly calcified basal branch, which is occasionally separated from the vertical one; the length of the basal branch, when it is present, very variable.

Peduncle variable in length, sometimes long, slender and cylindrical, sometimes short and stout, much broader at the base than at its junction with the capitulum.

Cirri, etc.—Cirri moderately long, curved; the hairs on their anterior margin, which is markedly convex in each joint, long, becoming shorter towards the base of each joint than they are at the apex, arranged on each joint in two vertical rows of about seven hairs each. First pair of cirri short, not very widely separated from the second; the anterior ramus slightly shorter than the posterior, each ramus bearing a circle of moderately stout bristles at the tip of the distal joint and otherwise profusely covered with hairs. *Anal appendages* moderately broad, compressed, reaching at least as far as the apex of the pedicel of the sixth cirri, bearing a dense tuft of moderately long hairs on the tip and several groups of stouter and shorter ones on the posterior

edge of the distal half; an imperfect separation into two joints sometimes visible. *Penis* stout and short; the proximal two-thirds covered with minute denticle-like chitinous teeth and bearing scattered hairs, devoid of annulation; the distal third closely and distinctly ringed, bearing a comparatively small number of scattered chitinous teeth, each with three comparatively long processes arising from a flat basis; the central process longer and more slender than those on either side; a tuft of short flattened hairs at the extreme apex of the organ, which is not retroverted, and a short flagellum.

MOUTH PARTS.—*Labrum* by no means bullate, bearing a tuft of short, fine hairs at the distal extremity. Palp bluntly conical, bearing a terminal bunch of stout hairs. *Outer maxilla* subquadrate, very broad; the distal margin sinuous; a fringe of stout hairs running all round the edge, but shorter on the distal margin than on the dorsal and ventral margins. *Maxilla* without an incisure, bearing a double row of stout bristles, which decrease in size gradually from above downwards and are interspersed with finer hairs; the body of the maxilla bearing several transverse rows of rather stout short hairs. *Mandible* with five teeth (including the inner angle, which is sometimes bifid); all the teeth rather short, not very widely separated from one another; the body of the mandible covered to a great extent with moderately slender, short hairs.

The capitulum of ovigerous individuals rarely measures more than 2 mm in length.

The external characters of this species are even more variable than is the case in *D. sinuata*, the variation being of a similar nature but extending further in the direction of reduction of the valves. The different forms that have been described as distinct species and to which reference is made in the synonymy printed above the description of the species, have been separated from one another mainly, but not solely, on external characters, and it will, therefore, be well to preface a discussion upon them by a brief statement as to the external differences which were believed to separate them.

(1) *D. bullata*, Aurivillius, had no carina or tergum; the scutum was somewhat sinuous but not angulate; the aperture was obliquely vertical, short, broader below than above; the capitulum was pointed above.

(2) *D. transversa*, Annandale, had a small linear or narrowly triangular carina; the tergum was absent or represented by a shapeless chitinous mass; the scutum was sinuous or almost angulate; the aperture was transverse or nearly so; the capitulum was produced above into a broad, rounded lobe.

(3) *D. angulata*, Aurivillius, had a linear carina with a broadly triangular base; there was no tergum; the scutum consisted of two branches meeting at an angle greater than a right angle, the uppermost being the longer and broader of the two; the aperture was almost vertical, narrow and slit-shaped; the capitulum was rounded above with a small lobe.

(4) *D. aperta*, Aurivillius, had a linear carina with a triangular base the lateral angles of which were produced into distinct branches; there was no tergum; the

scutum was somewhat L-shaped, but the angle at which the two branches met was rounded off; the aperture was vertical and broadly patent above; the capitulum was pointed at the apex, without a lobe.

(5) *D. cuneata* differed from *D. aperta* in that the scutum was divided a little above the point at which the two branches met and the aperture was not so patent.

Differences in the length of the peduncle I have not noticed, as this is a variable feature in all the species of the genus I have examined. The shape of the capitulum in species so soft and so liable to be distorted by alcohol as *D. sinuata* cannot be regarded as a reliable character on which to found specific diagnosis and is, as a matter of fact, extremely variable even in well-preserved specimens which otherwise resemble one another. The same is true of the exact direction of the aperture, the shape of which can apparently be altered at will by the living animal. As regards the latter point, moreover, all Aurivillius's figures seem to me to be incorrect in one particular, *viz.*, in the position assigned to the lower extremity of the opening. In his representations of *D. aperta*, *D. cuneata* and *D. bullata* this point is shown as considerably above the inferior extremity of the scuta, while in that of *D. angulata* the whole of the aperture appears to be confined to the space included between the scuta in their inferior half. In all the individuals I have examined it is possible, although often with difficulty, to see that the aperture extends from a point between the bases of the scuta nearly to the upper extremity of the capitulum. Frequently the lips are closely adpressed in the lower half of the opening, and occasionally this is the case both above and below the middle third. In transparent specimens it is difficult to see the separation between the lips when they are pressed together, but no such difficulty exists as regards specimens which are naturally somewhat opaque or have been stained by some suitable reagent such as borax carmine or hæmatoxylin.

The translucency of the capitulum and peduncle is a variable feature in this species as in many others, and so also is the development of chitinous points on the cuticle. Some individuals are quite transparent even after preservation in spirit, so that it is possible to examine their structure under the microscope without treating them with any special reagent. Others are much more opaque. Some have their whole external surface covered with small round chitinous tubercles of a deep yellow colour, while in others these points, although probably never altogether absent, can only be detected with great difficulty. The general opacity or translucency of the integument does not depend upon the degree of development of these tubercles, but is due to something inherent in the structure of the mantle and other parts of the animal.

The degree to which the valves are developed in different individuals or varieties of the species, is a character not devoid of a certain kind of consistency although by no means reliable as a means of diagnosis. My chief reason for considering the form I described as *Dichelaspis transversa* distinct from Aurivillius's *D. bullata* was the fact that all the specimens I had examined at the time the former was described possessed a carina. In the large series of specimens now before me, however, there are individuals with no carina, others in which a minute, needle-shaped calcareous body can

be detected with the aid of a high power of the microscope, others in which this body can just be seen with a hand lens, others in which it is larger and definitely though narrowly triangular, and others again in which the base is broadened out so as to form a second triangle; in a few the lateral angles of this triangle are lengthened into short branches. So far as the carina is concerned, the only point at which a break occurs in the series is the one at which it is possible to distinguish the base as a triangle; but this break is a very small one.

In some specimens it is possible to distinguish near the apex of the capitulum a chitinous structure of a yellowish colour which obviously represents the tergum. It never has a definite outline but fades imperceptibly into the surrounding membrane. In many individuals it is quite absent and in others it is only faintly indicated.

The scutum in its simplest form is a narrowly linear, sinuous structure at the side of the aperture. Often the two scuta of an individual differ in length. In a large proportion of the individuals I have examined a short piece of the lower end of the valve forms an angle with the slanting or tranverse portion at the side of the aperture. In a few specimens this lower branch of the scutum has a more considerable length, and in one specimen it is completely separated from the upper branch. In several the upper branch is noticeably broader than the lower one, but this is a rare occurrence. The angle at which the two branches meet is generally greater than a right angle, but in several of my specimens it is less.

The next question to be answered is, how far are the differences in one valve correlated with those in the others? Speaking generally, I may say that the development of the lower branch of the scutum corresponds, as a rule, with that of the basal branches of the carina. But this rule is not without exceptions, for the specimen in the Museum in which the basal branch of the scutum is best developed possesses a carina that is small and narrowly triangular as a whole. I have not seen an individual without a carina, however, in which the basal branches of the carina were apparent. The absence or presence of a chitinous tergum is not a character that can be correlated with any other.

External characters are not the only ones on which *D. angulata*, *D. aperta*, *D. cuneata*, *D. bullata* and *D. transversa* were originally separated from one another. Aurivillius lays considerable stress on the length of the anal appendages relative to the joints of the protopodite of the sixth cirrus, and also on the number of teeth on the mandible. He shows himself, however, that the former is a variable character in another species of the genus, namely, *D. warwickii* (*op. cit.*, pl. 8, figs. 20, 21), and I do not find it constant in any species of *Dichelaspis* or *Pœcilasma* of which I have been able to examine more than one or two examples. In these genera, moreover, the number of teeth on the mandible is frequently variable, sometimes being different on the two mandibles of one individual. This fact has been recognized in the published descriptions of some species and ignored in those of others, probably because the description is often based on the examination (or at any rate the dissection) of a single specimen. C. W. Aurivillius's descriptions of the cirri, etc., are very short, so that it is difficult to regard them as a basis for comparison; while he rarely mentions the penis. The

second of these facts is unfortunate, but it is perhaps as well that too much stress should not be laid on the cirri, at any rate in minute species, for these can only be examined properly in such species under a high power of the microscope and in conditions which render distortion and breakages difficult to avoid.

The soft parts of the three allied species *D. cor*, *D. sinuata* and *D. angulata* exhibit a close general similarity, but afford sound means of diagnosis as regards particular organs. In fully adult individuals the characters of the penis especially appear to be fairly constant. In *D. sinuata* this organ is comparatively slender, while in *D. cor* and *D. angulata* it is very stout. As regards the two latter species the curious three-pronged chitinous structures on the distal part of the organ in *D. angulata* afford a ready means of separation. The arrangement of the hairs on the anal appendages, moreover, although it is by no means constant, differs much more widely in the separate species than it does among the individuals of any one of them. In *D. cor* there is a dense apical tuft extending some distance down the posterior margin as an uninterrupted fringe; in *D. sinuata* there is no definite tuft at the tip, but the distal edge of the organ bears a regular double row of some six or seven hairs (or rather some twelve or fourteen, if both series are considered), which only extends a short distance down the posterior margin, while in *D. angulata* there is, as in *D. cor*, a definite apical tuft extending down the appendages behind as a fringe, but this fringe is interrupted at one or more points. Differences in the maxillæ, mandibles and other mouth parts also exist, but are less reliable.

APPENDIX.

LIST OF THE LEPADIDÆ IN THE COLLECTION OF THE INDIAN MUSEUM.

[Except when it is otherwise stated, each number refers to several or many individuals. The names of forms not recorded from the seas of British India and Ceylon are enclosed in square brackets.]

Family **LEPADIDÆ.**

Subfamily OXYNASPIDINÆ.

Genus **Oxynaspis**, Darwin.

Oxynaspis celata, Darwin.

O. celata, *Darwin, Mon. Cirr.*, Lep., p. 134.

Subsp. *indica*, Annandale.

$\frac{5757}{10}$.	TYPES. (On Antipatharian.) Off Akyab, Arrakan coast: 17 fathoms	Bengal Fisheries.
$\frac{5774}{10}$.	Off Akyab: 17 fathoms	,,
$\frac{5776}{10}$.	Off Orissa: 20 fathoms	,,
$\frac{5785}{10}$.	Off Ganjam coast: 24—30 fathoms. One specimen	,,

Subfamily LEPADINÆ.

Genus **Lepas**, Linné.

Subgenus ANATIFA, Brugière.

Lepas anserifera, Linné.

445.	Port Blair, Andamans	J. Wood-Mason, Esq.
619.	Andamans	,,
$\frac{1845-6}{7}$.	Station 94: 15—17 fathoms	Marine Survey.
$\frac{7932}{9}$.	Sandheads, Hughli River	Commander, Pilot Brig.
$\frac{1475-6}{10}$.	North Andaman Island	Marine Survey.
$\frac{5045}{10}$.	Akyab	?
$\frac{5111}{10}$.	Colombo	Colombo Museum.
$\frac{5427}{10}$.	Batavia, Java	Dr. P. N. van Kampen.
$\frac{5428-5627}{10}$.	Puri, Orissa	Mr. C. A. Paiva.
$\frac{5753}{10}$.	Sabang Bay, N. Sumatra	Dr. P. N. van Kampen.
$\frac{5772}{10}$.	Puri beach, Orissa coast	Dr. N. Annandale.
$\frac{5793}{10}$.	(On buoy.) Off Ganjam coast	Dr. J. T. Jenkins.
$\frac{5824}{10}$.	St. Croix, West Indies	Prof. H. J. Hansen.

Lepas anatifera, Linné.

L. anatifera, *Darwin, Mon. Cirr.*, Lep., p. 73.

$\frac{7845}{6}$.	Greenland		Stockholm Museum.
$\frac{5048}{9}$.	German Ocean		Asiat. Soc. Bengal.
$\frac{1015}{10}$.	Plymouth, England		Purchased.
$\frac{5763}{10}$.	Havre, France		Paris Museum (Prof. Bouvier).
$\frac{5799}{10}$.	Gulf of Naples		Dr. R. Dohrn.
$\frac{5823}{10}$.	Lat. 58° N., Long. 25° W.		Prof. H. J. Hansen.

Subsp. *indica*, Annandale.

$\frac{5778}{10}$.	TYPES.	Puri beach, Orissa	Dr. N. Annandale.

[*Lepas hillii*, Leach.]

L. hillii, *Darwin, op. cit.*, p. 77.

$\frac{5046}{10}$.	On ship from Brazil		Prof. E. Cornalia.
$\frac{5047}{10}$.	St. Andrews, Scotland		Prof. McIntosh.
$\frac{5825}{10}$.	Copenhagen. On ship from West Indies ..		Prof. H. J. Hansen.

[*Lepas pectinata*, Spengler.]

L. pectinata, *Darwin, op. cit.*, p. 86.

$\frac{8498}{6}$.	Hongkong		Sur.-Genl. R. Hungerford.
$\frac{5759}{10}$.	Mediterranean coast		Paris Museum (Prof. Bouvier).
$\frac{5789}{10}$.	Gulf of Naples		Dr. R. Dohrn.
$\frac{5826}{10}$.	.. ..		Prof. H. J. Hansen.

Subgenus Dosima, Gray.

[*Lepas fascicularis*, Ellis & Sol.]

L. fascicularis, *Darwin, op. cit.*, p. 92.

$\frac{5761}{10}$.	La Rochelle, France		Paris Museum (Prof. Bouvier).
$\frac{5822}{10}$.	Lat. 36° 50′ N., Long. 21° W.		Prof. H. J. Hansen.

Subgenus Hyalolepas, Annandale.

Lepas tenuivalvata (Annandale).

$\frac{5109\text{-}10}{10}$.	TYPES.	Ceylon	Colombo Museum.

Genus **Conchoderma**, Olfers.

Conchoderma virgatum (Spengler).

C. virgata, *Darwin, op. cit.*, p. 146.

$\frac{5}{10}\frac{76}{0}$.	Cape of Good Hope, S. Africa	Paris Museum (Prof. Bouvier).
$\frac{5}{10}\frac{79}{6}$.	Gulf of Naples	Dr. R. Dohrn.
$\frac{5}{10}\frac{79}{4}$.	(On *Chelone imbricata*.) Off Ganjam coast ..	Bengal Fisheries.
$\frac{5}{10}\frac{82}{9}$.	Copenhagen. On ship from W. Indies ..	Prof. H. J. Hansen.

[Var. *intermedia*, Annandale.]

$\frac{5}{10}\frac{03}{0}$.	TYPE. On ship from Brazil.	Prof. E. Cornalia.

Var. *hunteri*, Owen.

$\frac{5}{10}\frac{09}{2}$.	Sandheads, Hughli River. One specimen ..	Commander, Pilot Brig.
$\frac{5}{10}\frac{14}{1}$.	(From *Hydrus platurus*.) Ceylon. ..	British Museum (coll. E. E. Green, Esq.).
$\frac{5}{10}\frac{21}{6}$.	(On *Hydrus platurus*.) Port Blair, Andamans	Major A. R. Anderson, I.M.S.
$\frac{5}{10}\frac{68}{3}$.	(On crab.) Kroëng-Raja Bay, Sumatra ..	Dr. P. N. van Kampen.
$\frac{5}{10}\frac{80}{0}$.	(On buoy.) Off Ganjam coast	Dr. J. T. Jenkins.

[*Conchoderma auritum* (Linné).]

C. aurita, *Darwin, op. cit.*, p. 146.

$\frac{7}{10}\frac{90}{7}$.	(On *Coronula diadema* (Linné).) Vadso, Sweden	Stockholm Museum.
$\frac{5}{10}\frac{79}{7}$.	Gulf of Naples	Dr. R. Dohrn.
$\frac{5}{10}\frac{83}{1}$.	(On *Coronula diadema*.) Greenland ..	Prof. H. J. Hansen.

Genus **Heteralepas**, Pilsbry.

Subgenus PARALEPAS, Pilsbry.

Heteralepas xenophoræ (Annandale).

$\frac{5}{10}\frac{02}{7}$.	TYPES. (On shell of *Xenophora pallida*.) Station 233: 185 fathoms	Marine Survey

Heteralepas minuta (Philippi).

Alepas minuta, *Philippi, Enumeratio Mollusc. Siciliæ*, 1836, Tab. xii, fig. 23.

$\frac{5}{10}\frac{78}{7}$.	Gulf of Naples	Dr. R. Dohrn.

Subgenus Heteralepas, Pilsbry.

Heteralepas nicobarica, Annandale.

$\frac{5}{1}\frac{0}{0}\frac{3}{3}$. TYPES. Nicobars .. .. .. F. A. de Roepstorff, Esq.

[*Heteralepas gigas* (Annandale).]

Alepas gigas, *Annandale, Mem. Asiat. Soc. Bengal*, vol. i, p. 80.

$\frac{8}{6}\frac{4}{}\frac{1}{}\frac{8}{}$. TYPE. Bali Straits, Malay Archipelago .. Eastern Telegraph Co.

[*Heteralepas cygnus*, Pilsbry.]

H. cygnus, *Pilsbry, Bull. U. S. Nat. Mus.*, No. 60, p. 101.

$\frac{5}{1}\frac{7}{0}\frac{5}{}\frac{6}{}$. Locality unknown, probably West Indies .. Roy. Scottish Museum.

[*Heteralepas lankesteri* (Gruvel).]

Alepas lankesteri, *Gruvel, Ann. Mag. Nat. Hist.* (7), vol. vi, p. 195.

$\frac{5}{1}\frac{2}{0}\frac{3}{}\frac{2}{}$. CO-TYPES. Mona Channel, West Indies: 814 fathoms .. .. .. British Museum.

[*Heteralepas malayana* (Annandale).]

Alepas malayana, *Annandale, Mem. Asiat. Soc. Bengal*, i, p. 81.

$\frac{2}{7}\frac{7}{}\frac{6}{}\frac{2}{}$. TYPE. Gaspar Straits: 30 fathoms .. Capt. F. Worsley.

[*Heteralepas belli* (Gruvel).]

Alepas belli, *Gruvel, Trans. Linn. Soc.* (2), vol. viii, p. 278.

$\frac{5}{1}\frac{2}{0}\frac{3}{}\frac{3}{}$. CO-TYPES. Off coast of Cuba .. .. British Museum.

Subfamily **Pœcilasmatinæ**.

Genus **Pœcilasma**, Darwin.

Subgenus Pœcilasma, Darwin.

Pœcilasma kæmpferi, Darwin.

Pœcilasma kæmpferi, *Darwin, op. cit.*, p. 102.

Subsp. *dubia*, Hoek.

$\frac{5}{1}\frac{0}{0}\frac{2}{}\frac{6}{}$. (On *Echinoplax pungens*.) Station 233: 185 fathoms .. .. .. Marine Survey.

[Subsp. *aurantia*, Darwin.]

Pœcilasma aurantia, *Darwin*, *op. cit.*, p. 105.

$\frac{5}{10}\frac{7}{2}\frac{2}{8}$. (On *Geryon affinis*.) Cape Verde Islands, W. Africa: 692 metres .. .. H. S. H. The Prince of Monaco.

[Subsp. *novæ-angliæ*, Pilsbry.]

Pœcilasma kæmpferi novæ-angliæ, *Pilsbry*, *op. cit.*, p. 85.

$\frac{5}{10}\frac{6}{5}\frac{5}{0}$. (On *Geryon quinquedens*.) Martha's Vineyard, N. J.: 328 fathoms. One specimen .. Smithsonian Institution.

Pœcilasma fissum, Darwin.

$\frac{5}{10}\frac{0}{3}\frac{3}{9}$. Andamans. One specimen .. .. Dr. W. T. Blanford.

Pœcilasma minutum, Gruvel.

$\frac{5}{10}\frac{8}{4}\frac{4}{9}$. (On *Panulirus angulatus*.) Station 257: 143 fathoms .. .. .. Marine Survey.

$\frac{5}{10}\frac{6}{3}\frac{3}{5}$. (On *Paralia alcocki*.) Station 356: 156—200 fathoms .. .. .. ,,

$\frac{5}{10}\frac{6}{4}\frac{4}{5}$. (On *Homola megalops*.) Station 115: 188—220 fathoms .. .. .. ,,

$\frac{5}{10}\frac{6}{6}\frac{6}{6}$. (On capitulum of *Pœcilasma kæmpferi* subsp. *dubia* from *Echinoplax pungens*.) Station 233: 185 fathoms. One specimen .. ,,

Subgenus TRILASMIS.

Pœcilasma eburneum (Hinds).

$\frac{5}{10}\frac{3}{7}\frac{7}{7}$, $\frac{5}{10}\frac{6}{4}\frac{4}{4}$. (On irregular Echinoidea.) Station 291: 48-49 fathoms .. .. .. Marine Survey.

$\frac{5}{10}\frac{7}{2}\frac{2}{5}$. (On Echinoid.) Lat. 0° 14′ N., Long. 104° 4′ E.: 13—16 fathoms. One specimen .. Dr. P. N. van Kampen.

Genus **Megalasma**, Hoek.

Subgenus MEGALASMA, Hoek.

Megalasma carino-dentatum, Weltner.

TYPE LOST.

Megalasma minus, Annandale.

$\frac{8}{6}\frac{5}{8}\frac{8}{7}$. Andamans, off Port Blair .. .. Marine Survey.

$\frac{3}{7}\frac{0}{7}\frac{7}{4}$. Port Blair, Andamans .. .. J. Wood-Mason, Esq.

$\frac{942}{10}$.	Station 196: 484 fathoms	Marine Survey.
$\frac{4927}{10}$.	TYPES. Station 333: 401 fathoms ..	,,
$\frac{5051}{10}$	,, 197: 406 ,, ..	,,
$\frac{5376}{10}$.	,, 248: 224—284 fathoms	,,
$\frac{5640}{10}$.	(On irregular Echinoid.) Station 248: 224—284 fathoms	,,

[Subsp. *bellum*, Pilsbry.]

Megalasma bellum, *Pilsbry, Bull. Bur. Fisheries* (U. S. A.), xxvi, p. 183.

$\frac{5382}{10}$.	Hawaiian Islands	Dr. H. A. Pilsbry.

Subgenus Glyptelasma, Pilsbry.

[*Megalasma carinatum* (Hoek).]

Pœcilasma carinatum, *Hoek, "Challenger" Reports*, vol. viii, Cirr., p. 44.

$\frac{5234}{10}$.	CO-TYPES. Off coast of Cuba	British Museum (H.M.S. "Challenger").

[*Megalasma gracilius*, Pilsbry.]

M. gracile gracilius, *Pilsbry, op. cit.*, p. 88.

M. gracilius, *id., Proc. Acad. Nat. Sci. Philadelphia*, Sep. 1907, p. 414.

$\frac{5754}{10}$.	(From capitulum of *Scalpellum giganteum*.) Atlantic Cable, West Indies ..	Roy. Scottish Museum.
$\frac{5755}{10}$.	(From capitulum and peduncle of *Heteralepas cygnus*.) Locality unknown, probably West Indies	,, ,,

Genus **Dichelaspis**, Darwin.

Dichelaspis tridens (Aurivillius).

$\frac{5684}{10}$.	(From gills of *Thenus orientalis*.) Lat. 3° 58′ N., Long. 98° 47′ E.: 15—17 fathoms ..	Dr. P. N. van Kampen.
$\frac{5685}{10}$.	(From gills of *Thenus orientalis*.) North coast of Achin, Sumatra	,,
$\frac{5655}{10}$, $\frac{5722}{10}$.	(On *Xantho scaberrimus*.) Balasore Bay, Bengal coast	Bengal Fisheries.
$\frac{5658}{10}$.	(From gills of *Calappa exanthematosa*.) Bay of Bengal: 91—112 fathoms ..	Marine Survey.
$\frac{5721}{10}$.	(On *Thenus orientalis*.) Lat. 0° 14′ N., Long. 104° 4′ E.: 13—16 fathoms ..	Dr. P. N. van Kampen.
$\frac{5751}{10}$.	(From gills of *Thenus orientalis*.) Orissa coast	Bengal Fisheries.

Dichelaspis bathynomi, Annandale.

$\frac{5203}{10}$.	TYPES. (From *Bathynomus giganteus*.) Station 357 : 555 fathoms	Marine Survey.
$\frac{5662-3}{10}$.	(From *Bathynomus giganteus*.) Station 373 : 185 fathoms	,,
$\frac{5657}{10}$.	(From *Bathynomus giganteus*.) Off Ceylon : 225—594 fathoms	,,

Var. *perfidiosa*, Annandale.

$\frac{5765}{10}$.	TYPES. (From *Bathynomus giganteus*.) Station 373 : 185 fathoms	,,

Dichelaspis warwickii (Gray).

$\frac{5094}{10}$.	South coast of Ceylon	Colombo Museum.
$\frac{5631}{10}$.	(On *Goniosoma* sp.) N. end of Persian Gulf..	Marine Survey.
$\frac{5632}{10}$.	(On *Panulirus* sp.) Off Orissa coast ..	Bengal Fisheries.
$\frac{5641}{10}$.	(,, ,, ,,) Puri, Orissa ..	B. L. Chaudhuri, Esq.
$\frac{5642}{10}$.	(On *Thenus orientalis*.) Mouth of Hughli River	Bengal Fisheries.
$\frac{5643}{10}$.	(On *Murex* shell.) Bay of Bengal ..	,,
$\frac{5649}{10}$.	(On *Doclea japonica*.) Sandheads ..	Pilot Milner.
$\frac{5631}{10}$.	(On *Doclea hybrida*.) E. coast of India ..	Marine Survey.
$\frac{5652}{10}$, $\frac{5723}{10}$.	(On *Xantho scaberrimus*.) Balasore Bay, Bengal coast	Bengal Fisheries.
$\frac{5656}{10}$.	(From crabs.) Balasore Bay, Bengal coast	,,
$\frac{5675}{10}$.	Lat. 3° 40′ N., Long. 99° 10′ E.: 16—18 fathoms	Dr. P. N. van Kampen.
$\frac{5676}{10}$.	(On crab.) Lat. 1° 35′ S., Long. 104° 35′ E.: 6—8 fathoms	,,
$\frac{5677}{10}$.	(From gills of *Thenus orientalis*.) North coast of Achin, Sumatra	,,
$\frac{5678}{10}$.	(On crabs.) Lat. 0° 14′ N., Long. 104° 4′ E.: 13—16 fathoms	,,
$\frac{5679}{10}$.	(On crabs.) Lat. 5° 8′ N., Long. 100° 11′ E.: 11 fathoms	,,
$\frac{5680}{10}$.	(On crabs.) Off Obhlet, Achin, Sumatra: 16—18 fathoms	,,
$\frac{5681}{10}$.	(On *Scyllarus* sp.) Lat. 0° 14′ N., Long. 104° 4′ E.: 13—16 fathoms	,,
$\frac{5720}{10}$.	(On *Thenus orientalis*.) Lat. 0° 14′ N., Long. 104° 4′ E. : 13—16 fathoms ..	,,
$\frac{5752}{10}$.	(On *Thenus orientalis*.) Orissa coast ..	Bengal Fisheries.

5059/10.	(On *Doclea ovis*.) Orissa coast ..	Marine Survey.
5724/10.	(On *Goniosoma crucifera*.) Puri, Orissa ..	Bengal Fisheries.
5766/10.	(On back of large specimen of *Serranus lanceolatus*.) Off entrance to the Eastern Channel, mouth of River Hughli ..	Dr. J. Travis Jenkins.
5767/10.	(On *Neptunus sanguinolentus*.) Puri beach, Orissa coast	Dr. N. Annandale.
5827/10.	(On *Dorippe*.) Eastern Asia	Prof. H. J. Hansen.

Dichelaspis geryonophila (Pilsbry).

5637/10.	(On *Geryon affinis*.) Station 248: 224—284 fathoms	Marine Survey.
5638/10.	(On *Geryon quinquedens*.) Martha's Vineyard, N. J.: 328 fathoms	Smithsonian Institution.

Var. *fissicarina*, Annandale.

5798/10.	TYPES. (On *Geryon quinquedens*.) Martha's Vineyard, N. J.: 328 fathoms ..	Smithsonian Institution.

Dichelaspis grayii, Darwin.

5028/10.	(On *Enhydrina* sp.) Lower Burma ..	Marine Survey.
5041/10.	(On *Hydrophis* sp.) Mergui	Dr. J. Anderson.
5064/10.	(On *Distira robusta*.) South Arcot ..	?
5743/10.	(On *Hydrophis spiralis*.) Trivandrum, Travancore State	Trivandrum Museum.
5768/10.	(On *Hydrophis gracilis*.) Madras ..	Dr. J. R. Henderson.
5769/10.	(On *Hydrophis fasciatus*.) Puri beach, Orissa coast	Dr. N. Annandale.
5770/10.	(On *Distira robusta*.) Puri beach, Orissa coast	,,
5771/10.	(On *Enhydrina valakadien*.) Puri beach, Orissa coast	,,

Var. *pernuda*, Annandale.

5747/10.	(On *Hydrophis* sp.) Madras coast ..	Madras Museum.
5748/10.	TYPES. (On *Enhydrina valakadien*.) Madras coast	,,
5749/10.	(On *Distira viperina*.) Puri	Dr. J. Travis Jenkins.

Dichelaspis stella, Annandale.

5636/10.	TYPES. (From gills of *Homola megalops*.) Stations 115 and 235: 188—419 fathoms	Marine Survey.

Dichelaspis rhinoceros, Annandale.

$\frac{5639}{10}$.	TYPES. (From gills of *Encephaloides armstrongii*.) Bay of Bengal: 93 fathoms ..	Marine Survey.

Dichelaspis cor, Aurivillius.

$\frac{5682}{10}$.	(On crab.) Kroëng-Raja Bay, Achin, Sumatra	Dr. P. N. van Kampen.
$\frac{5667}{10}$.	(From *Scylla serrata*.) Rangoon River ..	Dr. N. Annandale.
$\frac{5648}{10}$.	(,, ,, ,,) Karachi ..	Messrs. Hume and Day.
$\frac{5241}{10}$.	(,, ,, ,,) Ganges delta ..	Purchased in Calcutta Market.
$\frac{5750}{10}$.	(From gills of *Scylla serrata*.) Balasore Bay, Bengal coast	Bengal Fisheries.
$\frac{5762}{10}$.	CO-TYPES of *D. maindroni*, Gruvel, vars. A and B. Karachi	Paris Museum (Prof. Bouvier).
$\frac{5764}{10}$.	,, ,, ,, ,, var. C ,,	,,

Var. *coutierei*, Gruvel.

$\frac{5758}{10}$.	CO-TYPES of *D. coutierei*, Gruvel. Djibouti, French Somaliland	,,

Dichelaspis sinuata, Aurivillius.

$\frac{5199}{10}$.	(From gills of *Neptunus pelagicus*.) North end of Persian Gulf	Marine Survey.
$\frac{5672}{10}$.	(From gills of *Thenus orientalis*.) North of Achin, Sumatra	Dr. P. N. van Kampen.
$\frac{5673}{10}$.	(On *Thenus orientalis*.) Lat. 3° 40′ N., Long. 99° 10′ E.: 16—18 fathoms ..	,,
$\frac{5674}{10}$.	(From gills of *Thenus orientalis*.) Lat. 3° 58′ N. Long. 98° 47′ E.: 15—17 fathoms.	,,
$\frac{5719}{10}$.	(On *Xantho scaberrimus*.) Balasore Bay, Bengal coast	Bengal Fisheries.
$\frac{5821}{10}$.	(From gills of *Echinoplax pungens*.) Andaman Sea: 130—250 fathoms ..	Marine Survey.

[*Dichelaspis darwinii*, Filippi.]

$\frac{5828}{10}$.	(On gills of *Lupea*.)	Prof. H. J. Hansen.

Dichelaspis angulata, Aurivillius.

$\frac{5744}{10}$.	(From gills of *Goniosoma crucifera*.) Orissa coast	Bengal Fisheries.

$\frac{5629}{10}$.	(From gills of *Neptunus pelagicus*.) Orissa coast	Bengal Fisheries.
$\frac{5745}{10}$.	(From gills of *Neptunus sanguinolentus*.) Orissa coast	,,
$\frac{5628}{10}$.	TYPES of *D. transversa*, Annandale. (From gills of *Neptunus pelagicus*.) North end of Persian Gulf	Marine Survey.
$\frac{5630}{10}$.	(From gill of *Panulirus* sp.) Orissa coast ..	Bengal Fisheries.
$\frac{5647}{10}$.	(From gills of *Goniosoma cruciferа*.) Puri, Orissa	Mr. C. A. Paiva.
$\frac{5654}{10}$.	(From crabs.) Balasore Bay, Bengal coast	Bengal Fisheries.
$\frac{5658}{10}$.	(From gills of *Calappa exanthematosa*.) Bay of Bengal: 91—112 fathoms ..	Marine Survey.
$\frac{5726}{10}$.	(From gills of *Panulirus* sp.) Bombay ..	Dr. A. D. Imms.

LIST OF INDIAN MARINE STATIONS REFERRED TO IN THIS PAPER.

No. of Station.	Date.	Position.	Depth in fathoms.	Bottom temperature.	Nature of bottom.	Species taken.
94	28-ii-90	Off Vizagapatam coast	15—17	....	Hard sand, etc.	*Lepas anserifera*, probably from surface.
115	9-xii-90	11° 31′ 40″ N., 92° 46′ 40″ E.	188—220	56° F.	Green mud.	*Pœcilasma minutum.* *Dichelaspis stella.*
196	16-i-95	12° 54′ 30″ N., 72° 22′ 0″ E.	484	48·25° F.	Grey ooze and globigerina ooze.	*Megalasma minus.*
197	20-i-95	9° 34′ 57″ N., 75° 36′ 30″ E.	406	48° F.	Green mud.	*Megalasma minus.*
233	6-xii-97	13° 17′ 15″ N., 93° 10′ 0″ E.	185	53·5° F.	Sand.	*Heteralepas xenophoræ.* *Pœcilasma kæmpferi* subsp. *dubia.* *Pœcilasma minutum.*
235	8-iv-98	14° 13′ 0″ N., 93° 40′ 0″ E.	370—419	....	Grey mud.	*Dichelaspis stella.*
248	17-x-98	8° 37′ 0″ N., 75° 37′ 30″ E.	224—284	52—54° F.	Sand.	*Megalasma minus.* *Dichelaspis geryonophila.*
257	22-iv-99	7° 15′ 0″ N., 77° 46′ 0″ E.	143	....	Sand.	*Pœcilasma minutum.*
291	1-xi-01	26° 22′ 0″ N., 56° 10′ 0″ E.	48—49	....	Mud.	*Pœcilasma eburneum.*
333	19-iv-04	6° 31′ 0″ N., 79° 38′ 0″ E.	401	....	Soft green mud.	*Megalasma minus.*
356	16-xii-05	17° 59′ 0″ N., 57° 22′ 30″ E.	156—200	58° F.	Green mud.	*Pœcilasma minutum.*
357	17-xii-05	16° 51′ 0″ N., 54° 55′ 0″ E.	555	48° F.	Green mud.	*Dichelaspis bathynomi.*
373	19-xii-06	15° 59′ 10″ N., 93° 39′ 45″ E.	195	52·4° F.	Soft green mud, rocks, etc.	*Dichelaspis bathynomi.*

EXPLANATION OF PLATE VI.

FIGS. 1—6.—Specimens of *Dichelaspis angulata* from the Bay of Bengal—

Figs. 1, 1*a*, 2.—Form with short, stout scuta, with or without a carina, with relatively large chitinous points.

,, 3.—Form with a rudimentary carina and with slender scuta, the lower extremities of which are produced into a fine chitinous filament.

,, 4.—Form without a carina, with the scutum markedly sinuous; the aperture transverse.

,, 5, 5*a*.—Form with stout, curved scuta and a well-developed carina.

,, 6.—Forms with slender scuta with distinct basal branches; carina rudimentary.

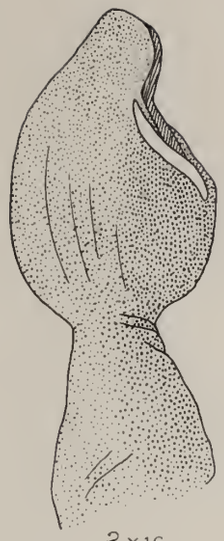
,, 7—10.—Specimens of *Dichelaspis cor* from a single crab, illustrating variation in the direction of the aperture and in the concentric lines on the external surface of the capitulum.

,, 11—13.—Specimens of *Dichelaspis geryonophila* from the Laccadive Sea (from *Geryon affinis*).

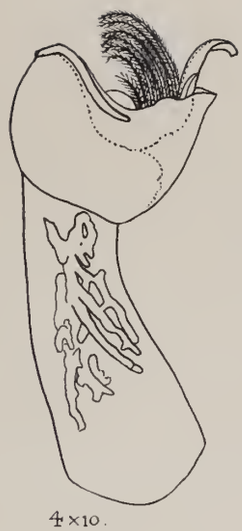
,, 14, 15.—Specimens of *D. geryonophila* from Martha's Vineyard, New Jersey. All these individuals are from one specimen of *Geryon quinquedens*, but those represented in fig. 15 are the types of the variety *fissicarina*.

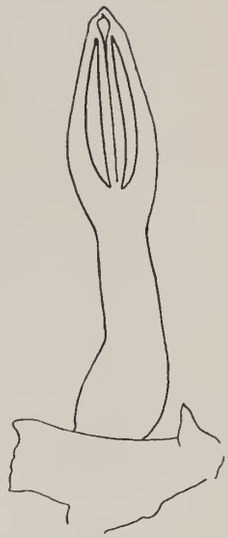
1x16.

1a x 16.


2 x 16.

3 x 10.

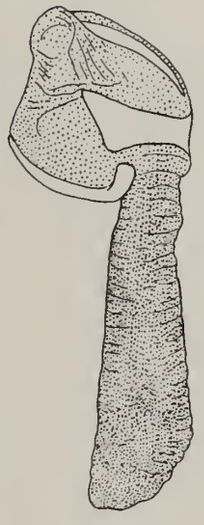

4 x 10.


5 x 10.

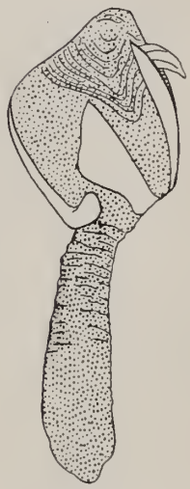
5a x 10.

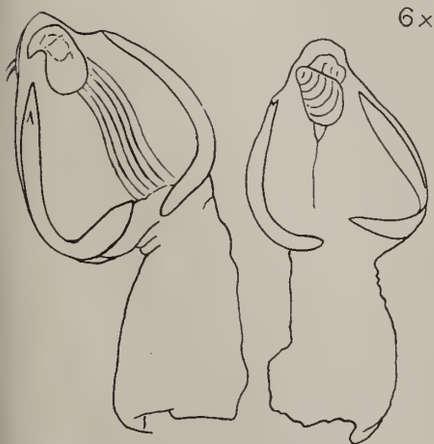
6 x 10.

7 x 10.


8 x 10.

9 x 10.


10 x 10.


11 x 10.

12 x 10.

13 x 10.

14 x 10.

15 x 10.

VARIATION IN DICHELASPIS.

Figs. 1-6. D. angulata. Figs. 7-10. D. cor. Figs. 11-15. D. geryonophila.

EXPLANATION OF PLATE VII.

FIGS. 1, 2.—Forms of *Dichelaspis tridens*.

,, 3.—*Dichelaspis bathynomi* (typical form).

,, 4.—*D. bathynomi* var. *perfidiosa*.

, 5—7.—*Pœcilasma minutum*. Figure 5 represents an old and fig. 6 a young individual.

,, 8.—Carina of *Pœcilasma kæmpferi* subsp. *dubia* from the Gulf of Manaar.

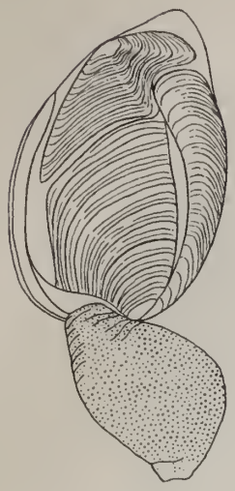
,, 9, 9*a*.—*Heteralepas nicobarica*, sp. nov.

,, 10, 10*a*, 10*b*.—Valves of *Oxynaspis celata* subsp. *indica*—

Fig. 10.—Scutum and tergum (external surface).

,, 10*a*.—Scutum of another individual (internal surface).

,, 10*b*.—Carina.



1×12.

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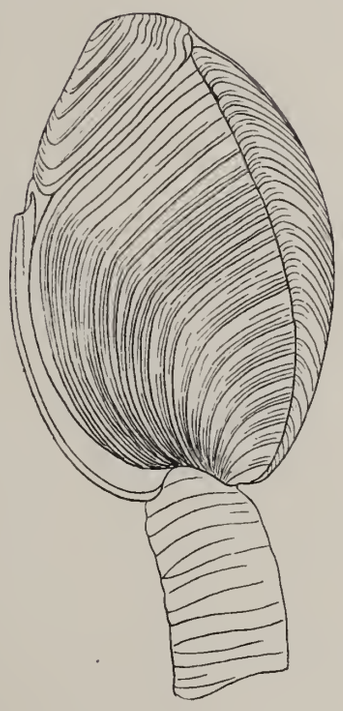
3×12.

4×12.

10a×6.



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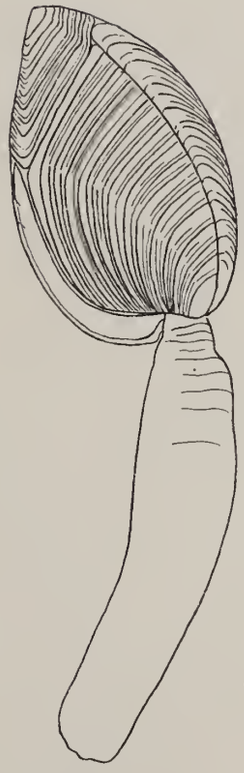

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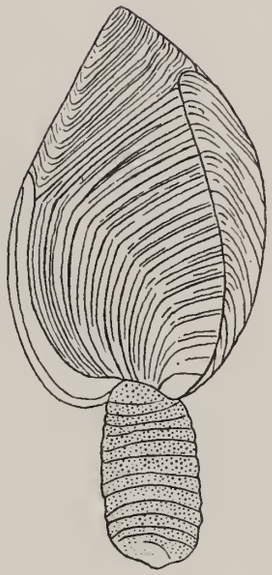
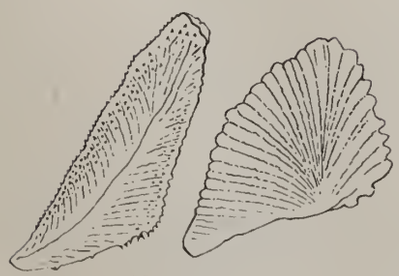


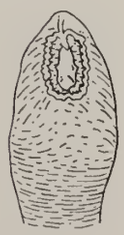
7×12.

10 b×6.



10×6

8×8.



9a×2.

9×2.

POECILASMA, DICHELASPIS, HETERALEPAS, and OXYNASPIS.

Figs 1,2. D. tridens. Figs 3,4. D. bathynomi. Figs. 5,6,7. P. minutum. Fig 8. P kaempferi (Indian race)
Figs. 9,9a H. nicobarica. Figs. 10,10a,10b O celata (Indian race).

A DESCRIPTION OF THE DEEP-SEA FISH CAUGHT BY THE R.I.M.S. SHIP "INVESTIGATOR" SINCE THE YEAR 1900, WITH SUPPOSED EVIDENCE OF MUTATION IN *MALTHOPSIS*.

By R. E. Lloyd, *M.B., D.Sc. (Lond.), Capt., I.M.S., Acting Professor of Biology, Medical College, Calcutta, formerly Surgeon Naturalist, Marine Survey of India.*

Four years ago Colonel Alcock drew my attention to the fact that a number of unknown fish had been obtained of late years by the "Investigator." The description of these had been delayed until the results of the German exploratory vessel "Valdivia," which operated in deep waters round India, had been published.

Colonel Alcock's catalogue of the deep-sea fish taken by the "Investigator" was published ten years ago. Since then a few new forms have been described from time to time. Dr. Annandale has asked me to include these descriptions and to mention the more interesting of the known forms obtained since the compilation of the catalogue, some of which have not been previously recorded from Indian seas. The previous descriptions have been given *verbatim* so that the whole may form an appendix to the catalogue published in 1899. Five genera and nineteen species are described here for the first time.

Systematic work cannot always be pursued with unbroken facility. There are among the collection four small communities of the genus *Malthopsis*. These include a number of types which although distinct, cannot I think be treated as separate species in the ordinary sense of the word, for it is hardly possible to suppose that these types arose in separate areas and subsequently came together again so as to exhibit the remarkable distribution obtained. This question is dealt with separately at the end of the systematic part of the paper.

I. SYSTEMATIC PART.

Subclass ELASMOBRANCHII.

Order **PLAGIOSTOMI.**

Suborder **Selachii.**

Family SCYLLIDÆ.

Scylliorhinus indicus, Brauer.

Wissen. Ergebn. Deutsch. Tiefsee-Exped. "Valdivia," Bd. xv, part i, p. 8, pl. xiv (1906).

One specimen 30 cm. in length from 604 fathoms in the Gulf of Oman, Station 339. Registered No. $\frac{11.4.4}{1}$.

Suborder **Batoidei.**

Family RAIIDÆ.

Raia andamanica, sp. nov.

Illustr. Zool. "Investigator," Fishes, pl. xlvi, fig. 2 (1909).

Raia, sp. nov., *Annandale, Mem. Ind. Mus.*, ii, part 1, p. 3.

The breadth of the disk is slightly greater than the length measured to the end of the pelvic fin in the proportion of 19 to 17. The tail is long, the distance between the tip of the tail and the centre of the vent is much greater than the distance between the snout and the vent in the proportion of 3 to 2.

The snout projects very slightly. The antero-lateral borders, which are markedly sinuous, meet at less than a right angle. The lateral and posterior angles are both evenly rounded, but the lateral angle is less broadly rounded than the posterior. The greatest diameter of the eye is slightly greater than the smallest interorbital distance, and is a quarter of the length of the snout measured from the centre of the upper jaw. The spiracle is close behind the eye; its greatest diameter is about half that of the eye. The mouth is nearly a transverse line, being very slightly curved; its length is one-third that of the snout. The anterior limit of the nostril is removed from the corner of the mouth by a distance equal to the breadth of the mouth. There are 54 rows of teeth in the upper jaw, 40 in the lower. The teeth are on an oval base; the front ones are worn flat, the back ones have a low pointed cusp.

The dorsal fins are small, the anterior being somewhat larger than the posterior; they are close to the end of the tail and are separated by a distance less than the length of the base of either. The caudal fin is only represented by a narrow fold of skin on the lower side.

There is a continuous row of eight large thorns on the supraorbital ridge; the first of these is in front of the eye, the last behind it.

There are about 15 large spines over the rostral cartilage which does not extend quite to the end of the disk.

There is a single series of large spines in the mid dorsal line extending from a short distance behind the level of the spiracles, to the tail, where the series becomes less regular. Besides this, most of the upper surface except the postero-lateral margins of the pectoral fins is covered with small denticles.

The sides and top of the tail are spiny, the spines being larger on the upper surface.

The entire lower surface is smooth and naked except the distal half of the tail, which bears a few very small spines.

Colour, a uniform slaty grey above and below.

A small male 21 cm. in length from 279 fathoms in the Andaman Sea, Station 332. Registered No. F $\frac{11}{1}\frac{29}{}$.

Raia reversa, Lloyd.

Ann. Mag. Nat. Hist. (7), vol. xviii, p. 310 (1906); and *Illustr. Zool. "Investigator,"* Fishes, pls. xxxix and xli (1908).

The greatest breadth of the disk is equal to the length from the snout to the root of the tail.

The cloaca is slightly nearer the end of the snout than the end of the tail.

The interorbital space is $\frac{1}{4}$ the length of the snout measured from an eye or the middle of the mouth.

The anterior borders of the pectoral fins are sinuous and together form an angle of about 80°.

The snout is prominent.

The lateral angle of the pectoral fins is rounded.

The spiracle is large; its greatest diameter equals that of the eye.

The skin over the skull, but not over the snout, is covered with fine denticles.

The anterior half or more of the pectoral fins is covered with small denticles.

There are two series of larger spines on the pectoral fins, one series of about twenty opposite the shoulder-girdle (male characteristic probably) and another of about fifteen opposite the eye.

There is one large white stellate spine in front of the eye and two or three smaller ones behind.

There are four or five similar spines in the mid-dorsal line.

On the dorsum of the tail are three regular rows of large spines, those of the middle row being about half as numerous as those of the lateral rows.

The sides of the tail are spiny.

The lower surface of both disk and tail is smooth and devoid of spines.

The two dorsal fins are equal in length and are in contact at their bases; the caudal fin is a minute fold.

The mouth is transverse in its outer part and curved in the middle; its breadth is exactly half the length of the snout.

There are forty-two rows of teeth across both upper and lower jaw.

The teeth in the middle of the series are long and curved; their bases are heart-shaped.

Colours in the fresh state:—The upper surface of the disk is pure white, passing into dark grey at the margin of the pectoral fins. The upper surface of the pelvic fins and claspers is grey. The iris is black, but the pupil had a white milky appearance: the anatomical cause of this was unfortunately not made out in the fresh state. The entire lower surface is purplish black. In consistency the whole body is soft and flabby; when taken from the trawl it was rolled up in a cylindrical posture.

The single specimen (a male), measuring 60 cm. in its greatest length and 33 cm. in its greatest breadth, was taken from 820 fathoms in the Arabian Sea off the Baluchistan coast. Station 367.

The most characteristic features of this species are the soft, flabby consistency in the fresh state and the remarkable coloration, which suggested the name *R. reversa*. Registered No. F $\frac{1381}{1}$

In the same haul was obtained a black pillow-shaped egg with four hollow horns at the corners; this measures $2\frac{1}{2}$ by $1\frac{1}{2}$ inches. The horns are not equal in length: those of one pair are $2\frac{1}{2}$ inches long and are separated by a straight border; those of the other pair are $1\frac{1}{2}$ inches long and are separated by a tongue-shaped projection of the border, which constitutes a smaller fifth horn.

Raia philipi, Lloyd.

Ann. Mag. Nat. Hist. (7), vol. xviii, p. 309 (1906); *Illustr. Zool.* "*Investigator*," Fishes, pls. xl and xli (1908).

The greatest breadth of the disk is equal to the greatest length, including the ventral fins.

The ends of the snout and tail are equidistant from the cloacal orifice. The snout is slender and prominent. The interorbital space is $3\frac{2}{3}$ in the length of the snout, measured from an eye or the middle of the mouth.

The anterior borders of the pectoral fins, which are somewhat sinuous, together form an angle of about 85°.

The lateral angles are rounded. The spiracle is large, its greatest diameter equals that of the eye.

Numerous small spinules occur on the upper surface of the tip of the snout and close to the antero-lateral margin in its posterior half only.

The superciliary ridge bears four spines in front and three behind.

There are five mid-dorsal spines in the branchial region.

Between the ocellus and the margin of the pectoral fin is a group of lanceolate denticles pointing inwards (probably characteristic of the male).

The whole lower surface of the snout is covered with fine denticles.

On the dorsum of the tail are three somewhat irregular rows of spines. The tail is naked below, the sides of the tail are spiny.

The mouth is widely but distinctly V-shaped; in width it is $1\frac{7}{8}$ in the length of the snout.

There are eighty rows of teeth in the upper jaw and sixty in the lower. Teeth low and triangular, on a rhomboidal base.

The edges of the nasal valves are deeply fimbriated and are united across the middle line by a distinct fold of skin, which is separated from the upper jaw by a deep curved groove.

The dorsal fins are equal in length; the distance between them is greater than the length of either. Caudal fin small.

Colour uniform brown above, with a dark ocellus at the base of each pectoral fin, surrounded by a paler ring. Uniform white below; the tail shows dark mottling on its lower surface.

One small male specimen, measuring 36 cm. in its greatest length and 23 cm. in its greatest breadth, was taken from 130 fathoms in the Gulf of Aden. Station 360. Registered No. $\frac{1383}{1}$.

There are now six species of the genus *Raia* in the collection, each of which is represented by a single specimen Four of these are from depths of over 200 fathoms. Two are from more shallow water. Of these two *R. powelli* is from 67 fathoms in the Gulf of Martaban, the other, *R. philipi*, is from 130 fathoms in the Gulf of Aden. These two resemble one another more closely than any of the others. There is in the Indian Museum another specimen of the genus which was brought ashore by fishermen at Travancore from water which must have been less than 10 fathoms in depth. This specimen closely resembles *R. powelli*[1] but in some ways it also resembles *R. philipi*. It is possible that the three specimens are in a wide sense of one species which occurs rarely in the shallow waters around India and shows local variation. The specimens from Martaban and Travancore are both females, while the specimen from Aden is a male. It has been suggested to me that the differences exhibited may be of a sexual nature At present it does not seem advisable to describe the specimen from Travancore as a new species, nor is it safe to infer without evidence that *R. philipi* is the male form of *R. powelli*. The measurements of the three specimens will be given in detail:—

Name of specimen	*Raia powelli.*	*Raia*, sp.	*Raia philipi.*
Locality	G. of Martaban.	Trivandrum.	G. of Aden.
Depth	67 fathoms.	10 fathoms (?).	130 fathoms.
Sex	Female.	Female.	Male.
Total length	318 mm.	475 mm.	350 mm.
Breadth	191 ,,	315 ,,	220 ,,
Snout to pelvic fin	187 ,,	290 ,,	220 ,,
Vent to snout	150 ,,	235 ,,	174 ,,
Width of mouth	26 ,,	46 ,,	32 ,,
Corner of mouth to front end of nostril	17 ,,	25 ,,	16 ,,
Length of snout from centre of upper jaw	54 ,,	78 ,,	60 ,,
Greatest diameter of eye	9 ,,	12 ,,	11 ,,
Spiracle	9 ,,	17 ,,	11 ,,
Interorbital distance	13 ,,	22 ,,	16 ,,
Position of greatest breadth—			
A, from snout	93 ,,	147 ,,	135 ,,
B, from end of pelvic fin	94 ,,	143 ,,	85 ,,
Number of teeth—			
Upper jaw	55 ,,	75 ,,	80 ,,
Lower jaw	55 ,,	75 ,,	60 ,,
Reg. No...	$\frac{235}{1}$	$\frac{2708}{1}$	$\frac{1383}{1}$

As regards the form of the disk *R. powelli* and the Travancore specimen resemble one another exactly, and differ widely from *R. philipi*, in which the greatest breadth is much further back. As regards the shape of the mouth the Travancore specimen is intermediate between the other two (text-fig. 1), while as regards the relative

[1] See Annandale, *Mem. Ind. Mus.*, vol. ii, No. 1, p. 16.

proportions of eye and spiracle it differs from the others, which resemble one another in this respect. All three specimens are of the same colour and have the same characteristic ocellus at the base of the pectoral fin.

The shape of the teeth is alike in the three specimens; the same may be said of the form and disposition of the dorsal and caudal fins.

A. B. C.

Fig. 1.—Mouths of *Raia*: A. = *R. powelli*; B. = *Raia* sp.; C. = *R. philipi*.

Family TORPEDINIDÆ.

Narcine mollis, Lloyd.

Lloyd, Rec. Ind. Mus., vol. i, p. 8 (1907); *Annandale, Mem. Ind. Mus.*, vol. ii, no. 1, p. 43, pl. iii*a*, figs. 3, 3*a*.

Illustr. Zool. "Investigator," Fishes, pl. xlvi, figs. 1, 1*a* (1909).

The vent is slightly nearer the anterior margin of the snout than the tip of the tail. The disk is evenly rounded, it is slightly broader than long. The margin of the flap formed by the confluent nasal valves is most prominent at the sides, unlike *N. timlei*, the other Indian species. The whole quadrangular space which lies between the two nasal clefts is nearly as long as it is broad. In *N. timlei* this space is three times as broad as it is long.

The anterior dorsal is slightly smaller than the posterior; it commences just behind the ventrals. The dorsal and caudal fins have blunt pointed ends and the folds of skin along the sides of the tail are obvious, but not prominent. The dorsal and ventral parts of the caudal fin are confluent.

The teeth are in 10 to 12 rows in both jaws; the front row has only 3 or 4 teeth; behind this the number gradually increases in succeeding rows up to about 16. The teeth of the front rows have triangular, flat surfaces; behind, the teeth bear a sharp median cusp.

The spiracle is immediately behind the eye and is the same size as the eye.

The electric organs seem well developed. The fish gave no perceptible shock to the hand and died soon after capture.

Round the margin of the disk, and along the sides of the tail, and over the snout, are the openings of mucous pores symmetrically arranged.

Consistency and general appearance distinctly bathybial. Colour dark brown above, greyish brown below.

Habitat.—Gulf of Aden; 130 fathoms. Station 360. Registered Nos. F $\frac{1}{1}\frac{4}{4}\frac{5}{5}\frac{6-7}{6-7}$.

Benthobatis moresbyi, Alcock.

Ann. Mag. Nat. Hist. (7), vol. v, p. 145 (1898); *Cat. Indian Deep-Sea Fish*, p. 18 (Calcutta, 1899); *Illustr. Zool. "Investigator,"* Fishes, pl. xxvi (1899).

One small specimen from 585 fathoms, off the south coast of Arabia. Station 358. Registered No. F $\frac{1}{1}\frac{3}{3}\frac{1}{1}\frac{5}{5}$.

Order TELEOSTEI.

Suborder Malacopterygii.

Family ALEPOCEPHALIDÆ.

Genus Platytroctegen, nov.

Resembling the genus *Platytroctes* (Günther), but differing from it in possessing small but well-developed pelvic fins. The deep folds of skin which in *Platytroctes* form the dorsal and ventral contours of the body are not empty as in that genus but are occupied by a thick layer of connective tissue. The scales are not keeled.

Platytroctegen mirus, sp. nov.

B. 6, D. 23, A. 23, P. 28, V. 5.

The greatest depth of the body is one-third of the total length without the caudal. The length of the head is slightly more than a quarter of the total without the caudal. The diameter of the eye is slightly less than one-third the length of the head. The length of the snout is equal to half the diameter of the eye.

Minute teeth occur in a single row on the premaxillaries, maxillaries and dentaries; there are a few small teeth on the vomer. The palatines are toothless.

The innermost of the four gills is half the length of the others. Filaments and rakers are about a third of the diameter of the eye, the gill-rakers of the first arch are longer than the others.

A small tubular papilla with an apical pore rises from the skin a short distance behind the operculum on a level with the centre of the eye.

The upper surface of the head, which is triangular and nearly flat, is bounded on either side by straight supraorbital ridges, converging in front. The supraorbital ridge, the infraorbital and pre-opercular bones each support a muciferous canal opening at intervals.

The lower ends of the clavicles, which together form a remarkable bony spine, are in contact up to their apices.

The gill-cover of the left side overlaps that of the right side at its lower end, where it contains an extra or seventh small branchiostegal ray, not represented on the right side.

Colour black.

One specimen measuring 13 cm. from the Bay of Bengal. Station 371, 500 fathoms. Registered No. $\frac{2382}{1}$.

This genus must be closely related to *Platytroctes*. It is most interesting that the two genera should be separated by such a major character as a pair of pelvic fins and yet resemble one another so closely in minor details. The similarity of their outward appearance is most remarkable.

The genus *Platytroctes* contains the species *P. apus*, Günther, and *P. procerus*, Brauer. The "Investigator" has obtained a single specimen of *P. apus* from near the Laccadive Isles. I have had the opportunity of comparing this with *Platytroctegen*. The main difference lies in the pelvic fins of the latter. With this is necessarily associated the fact that the contours of the body are not formed by empty skin as in *Platytroctes*, for pelvic fins could not be supported on a fold of empty skin. In *Platytroctes* the highest and lowest quarter of the body will transmit light, for the component layers of skin are in contact with one another internally. In our specimen of *P. apus* only those scales which cover the empty folds of skin are keeled. The scales covering the middle or thick part of the body are not keeled.

The specimen of *Platytroctes apus* obtained by the "Investigator" has a tubular papilla behind the operculum similar to that possessed by *Platytroctegen*. In both the system of muciferous canals on the head is as alike as though they were of the same species. Similarity in other features is equally great and yet the differences are very decided. Apart from the pelvic fins the following are the chief differences :—

1. The triangular cranium is depressed in the middle line in *Platytroctes apus*, —nearly flat in *Platytroctegen*.
2. The scales are keeled like those of a reptile in *Platytroctes apus*,—smooth in the other. In our specimen of *P. apus* only the upper and lower scales are keeled.
3. The remarkable clavicular spine is bifid at the tip in *Platytroctes*,—simple in the other.
4. The dorsal and anal fins are longer in *Platytroctegen*.

P. procerus is also furnished with the postopercular papilla. It is likely that the first example of *P. apus* which was taken by the "Challenger" in the Atlantic Ocean also possessed a similar organ which became detached or was otherwise overlooked.

Alepocephalus microlepis, sp. nov.

Illustr. Zool. "Investigator," Fishes, plate xliv, fig. 4 (1909).

B. 6, D. 20-22, A. 30-33, V. 5-6, P. 10, L.l. 125, L.tr. 30-35.

The head is slightly less than a third of the total without the caudal. The maximum height—which is at the base of the pectoral fin—is a sixth of the total. The vent is nearer to the gill-opening than to the base of the caudal fin. The ventrals are much nearer to the vent than to the gill-opening. The anal fin, being much longer

than the dorsal, commences anteriorly to it. The tenth ventral spine is opposite the first dorsal.

The diameter of the eye, which is equal to the length of the snout, is $3\frac{1}{4}$ in the total length of the head. The posterior end of the maxilla just reaches a vertical through the anterior border of the eye. The gill-covers are large and widely open; they contain six branchiostegals and are covered with soft brownish black skin, like the cranium and snout. The gill-rakers are numerous, long, lanceolate and acute. Pseudobranch small. The teeth are well-developed in the premaxillæ and dentaries, a few small teeth on palatines and three or four minute teeth on vomer.

In the mid-line of the back in continuation with the dorsal fin nearly up to the head is an empty fold of skin bearing scales as in *Aulastomatomorpha*. Scales throughout are very small and nearly circular. Stomach siphonal Eight pyloric cæca.

The chief peculiarities are the small and numerous scales and the extension of the ventral fin well beyond the level of the dorsal. Both of these features are associated in the genera *Conocara* and *Aulastomatomorpha*. On the whole the species resembles *A. niger* (Günth.) more than any other species. Colour black.

Five specimens, the longest 20 cm. in length. Stations 273, 336 and 297. Arabian Sea, 850, 700 and 600 fathoms. Registered Nos. $\frac{9\,3\,1}{1}-\frac{2}{}$, $\frac{2\,3\,7\,5}{1}$, $\frac{2\,3\,9\,1}{1}$.

Alepocephalus longiceps, sp. nov.

Illustr. Zool. "Investigator," Fishes, plate xliv, fig. 2 (1909).

B. 6, D. 20, A. 23, P. 10, V. 6, L.l. 52, L.tr. 5-1-6.

The length of the head is considerably more than a third of the total without the caudal. The greatest height of the body—which is at the level of the pectoral fins—is $6\frac{1}{2}$ in the total without the caudal. The vent is nearer the gill-opening than the end of the tail The attachment of the ventrals is somewhat nearer to the vent than to the gill-opening. The dorsal and anal fins are opposite to one another. The diameter of the eye is a fifth of the length of the head. The snout is long and pointed; its length is equal to the postocular length of the head. The upper jaw projects considerably beyond the lower as much as a distance equal to half the diameter of the eye. It is nearly horizontal when closed. The mouth is capable of wide extension. When closed the whole of the maxilla is in front of a vertical through the anterior border of the eye. The ends of the maxilla are very conspicuous and hang down slightly below the level of the lower jaw.

The gill-covers are voluminous and widely open below; one partially overlaps the other. They contain six branchiostegal rays, and are covered with soft black skin. The skin on the top of the head and snout is thin. The gill-rakers are numerous, long, lanceolate and acute. The gill-filaments are short and delicate. Pseudobranchs present but small.

The teeth on the premaxillary and dentary are very minute; on palatines and vomer present but minute. Stomach siphonal. Seven rudimentary cæca.

One specimen, 9 cm. in length. Bay of Bengal, 693 fathoms. Station 330. Registered No. $\frac{2}{1}\frac{5}{3}\frac{7}{7}\frac{4}{4}$.

Alepocephalus macrops, sp. nov.

Illustr. Zool. "Investigator," Fishes, plate xliv, fig. 3 (1909).

B. 6, D. 17, A. 20, V. 8, P. 8, L.l. 50, L.tr. 6-1-9 at v. fin.

The length of the head is as much as two-fifths of the total without the caudal.

The maximum height—which is just in front of the pectoral fins—is one-fifth of the length without the caudal.

The vent is equidistant from the base of the caudal and the nearest point of the opercular margin. The attachment of the ventrals is half-way between the vent and the nearest point of the opercular margin. The diameter of the eye is a third of the length of the head and is more than the length of the snout. The eyes are separated by less than their diameter. The snout is $3\frac{3}{4}$ in the length of the head. The mouth is nearly horizontal. The posterior end of the maxilla reaches nearly as far back as a vertical through the centre of the eye. The upper jaw slightly overlaps the lower. Teeth are conspicuous and occur on the premaxillæ, dentaries, palatines and vomers. The gill-cover is voluminous and widely open below; it is covered like the rest of the head with soft black skin. The gill-rakers are numerous, long, lanceolate and acute, the pseudobranch is present but small. The scales are rather large, their length and breadth are equal.

The dorsal and anal fins are approximately of the same length and lie opposite to one another. Stomach siphonal. There are seventeen pyloric cæca of moderate length.

Colour in spirits.—Head jet black, body brownish black, fins black with a bluish tinge.

One specimen, 11 cm. in length. Bay of Bengal off Arakan coast, 419 fathoms. Registered No. $\frac{1}{1}\frac{0}{0}\frac{9}{9}\frac{4}{4}$.

Aulastomatomorpha phosphorops, Alcock.

Ann. Mag. Nat. Hist. (6), vol. vi, p. 307 (1890).

A second specimen has been obtained from the Bay of Bengal off the Arakan coast, 1,100 fathoms. The type specimen was from the Arabian Sea, 1,000 fathoms. Registered No. $\frac{1}{1}\frac{0}{0}\frac{9}{9}\frac{3}{3}$.

Aulastomatomorpha cæruleiceps, Lloyd.

Ann. Mag. Nat. Hist. (7), vol. xviii, p. 308 (1906); *Illustr. Zool. "Investigator,"* Fishes, plate xlii, fig. 3 (1908).

B. 5, D. 18, A. 40, P. 7, V. 6.

Closely resembles *A. phosphorops*, from which it differs in the following particulars:—

1. The premaxillary teeth are fewer in number and are relatively larger; they are arranged in two sets, an anterior closely set group of eight or nine, and a posterior group of three with wide intervals between.

2. The interorbital space is wider than half the diameter of the eye.

3. The head is covered with a firm smooth skin just as in *A. phosphorops*, but in the new species the colour of this skin is a dark slaty blue. The colour of the rest of the body is brownish black. The bases of the fins have a blue tinge. The blue colour is partially preserved in spirit.

4. The total height is only $\frac{1}{8}$ of the total length excluding the caudal fin.

One specimen, 18 cm. long, from 1,005 fathoms in the Gulf of Oman. Station 354. Registered No. $\frac{1384}{1}$.

Narcetes affinis, Lloyd.

Ann. Mag. Nat. Hist. (7), vol. xviii, p. 308 (1906); *Illustr. Zool. "Investigator,"* Fishes, plate xlii, figs. 1, 1*a* (1908).

B. 7, A. 14, D. 17, V. 10, P. 13, L.l. 73, L.tr. 9-1-13.

Resembles *N. pluriserialis* (Garman), and differs from *N. erimelas* (Alcock) in the following particulars:—

1. There are seven branchiostegal rays.

2. The first ray of the anal fin is vertically below the eighth ray of the dorsal.

3. There is one enlarged tooth on either side of the vomer.

In all its proportions this species resembles *N. pluriserialis* very closely.

It differs from *N. pluriserialis* in the following respects:—

The teeth in the maxillæ are in two series, an outer series of small teeth and an inner series of larger ones.

There are only seventy-three scales in the lateral line.

The scales of the lateral line are large, measuring as much as $\frac{1}{4}$ inch in length.

The total length of the single specimen is 14 inches.

In the middle and hinder parts of the fish, one inch of the lateral line contains six scales, but in the front these scales overlap one another to a much further extent, so that one inch contains eight or nine scales.

In the anterior half of each scale of the lateral line is the wide opening of its tube; the margin of this opening is completed in front by a semicircular notch in the hinder edge of the scale which lies next in front.

Colour almost black; head and lining of gill jet-black.

One specimen, 14 inches long, from 1,005 fathoms in the Gulf of Oman. Station 354.

It is notable that *N. pluriserialis* (Garm.), which this species resembles in many ways, came from 1,010 fathoms in the Gulf of Panama. Registered No. $\frac{1385}{1}$.

Family STOMIATIDÆ.

Triplophos hemingi (MacArdle).

Photichthys hemingi, MacArdle, *Ann. Mag. Nat. Hist.* (7), vol viii, page 521 (1901); *Illustr. Zool. "Investigator,"* Fishes, plate xxxvi, fig. 2 (1905).

B. 14, D. 10, A. 61, P. 11, V. 9.

"Body black, covered with large deciduous scales. The length of the head is about one-seventh the length of the body without the caudal, and a little greater than the height of the body. The eyes are situated very near the anterior profile, about a diameter apart from one another, and are one-sixth the length of the head. There is a double row of small needle-like teeth in the upper jaw, and a single row of similar but smaller teeth in the mandible. A few small teeth in the palatines and vomer, but the latter has no fang. The surfaces of the mesopterygoids minutely denticulate. Gill-openings very wide. Four gills with short laminæ and long setose gill-rakers on the first three arches. The dorsal fin is situated above the space between the ventral and anal fins. The latter is extremely long and terminates about an eye-length from the caudal. The pectoral and ventral fins are nearly in the same plane, and the latter are almost midway between the former and the beginning of the anal fin. On the two specimens, one of which is very much damaged and the other by no means perfect, no adipose dorsal fin can be made out. The back is scaly and is not rugose. The luminous organs, which show up a dull opaque white against the dark background, may be grouped as follows :—

(1) One between the bases of all the branchiostegal rays.
(2) Sixteen between the symphysis of the jaw and the pectoral fins.
(3) Eight between the pectoral and the ventral fins.
(4) Five between the ventral and the anal fins.
(5) Thirty-five or thirty-six distributed along the bases of the anal rays. The last four groups may be taken as forming the lowest lateral row.
(6) and (7) A second and a third lateral row join about the ventral fins, and run as a single row of spots to near the caudal fin.
(8) A fourth row, not so distinct as the others, runs from behind the head to near the termination of the anal fin.

There are two glands on the head, one at the anterior angle of, and the other behind, the orbit.

Length 6—8 inches. Two specimens from the Bay of Bengal, 475 and 859—880 fathoms.

This fish bears several points of resemblance to *Gonostoma maderense* (Johnson, *Proc. Zool. Soc.*, 1890, p. 458), notably in the absence of fangs on the vomer and of an adipose dorsal fin; but in other respects it appears like a true *Photichthys*. It differs from *G. maderense* in having scales on the back and none on the cheek, and in having but a single row of teeth in the anterior portion of the lower jaw. It is quite

possible, too, that the small adipose fin may have got rubbed off in the 'Investigator' specimens." (MacArdle.)

Since the above description was drawn up by the late Captain A. F. MacArdle other specimens have been obtained. There is no doubt that the adipose fin is wanting in the species.

The illustration of this species was published simultaneously with the report on the deep-sea fish of the "Valdivia" Expedition, among which is the new genus *Triplophos*, Brauer. The resemblance between *Triplophos elongatum*, Brauer, and *Photichthys hemingi*, MacArdle, is manifest, consequently I have changed the name of the latter to *Triplophos hemingi*. The presence of two teeth on the palatines of this species is a distinction from *T. elongatum*.

Four specimens from the Bay of Bengal. Stations 165, 235, 277, 327. All have two teeth of moderate size set close together on each palatine.

One specimen (No. $\frac{9\,2\,8}{1}$) has a tooth on the left side of the vomer. Registered Nos. 13707, $\frac{9\,2\,8}{1}$, $\frac{1\,1\,3\,4}{1}$, $\frac{2\,3\,7\,6}{1}$.

Suborder **Haplomi.**

Family SCOPELIDÆ.

Myctophum (*Lampanyctus*) *gemmifer* (Goode and Bean).

Mem. Mus. Comp. Zool. Harvard, vol. xxii, p. 80, fig. 88 (1896).

One specimen 11 cms. in length from Station 184 in the Arabian Sea, 947 fathoms. This species has been previously recorded only from the Atlantic Ocean. Registered No. $\frac{1\,1\,5\,5}{1}$.

Sternoptyx diaphana, Hermann.

Der Naturforsher, 1781, vol. xvi, p. 8, and vol. xvii, p. 249.

Three specimens from the Bay of Bengal. Station 309, 765 fathoms. Registered Nos. $\frac{1\,0\,2\,5\text{-}2\,7}{1}$.

Cyclothone acclinedens, Garman.

Mem. Mus. Comp. Zool. Harvard, No. xxvi, vol. xxiv, p. 247, pl. J (1899).

One specimen, Bay of Bengal. Station 315, 705 fathoms. Registered No. $\frac{2\,3\,9\,2}{1}$.

Suborder **Apodes.**

Family NEMICHTHYDÆ.

Venefica proboscidea, Vaillant.

One specimen from the Gulf of Manaar, 888 fathoms, Station 307, agrees very closely with this species. In the original description the tail was said to be three-fifths of the total. In this specimen the vent is eleven inches from the nose and

nineteen inches from the tail. The proportions of the head are exactly as in Vaillant's specimen, which was taken from 2,200 metres off Morocco. Registered No. $\frac{2376}{1}$.

Serrivomer sector, Garman.

Mem. Mus. Comp. Zool. Harvard, No. xxvi, vol. xxiv, p. 320 (1899).

This specimen agrees exactly with Garman's detailed description, but it also agrees with the shorter description of *S. beanii* (Gill and Ryder).

Brauer records *Serrivomer sector* as having been taken by the "Valdivia" from the Indian Ocean, and remarks the similarity between *S. sector* and *S. beanii*. Arabian Sea, off Travancore. Station 306, 930 fathoms. Registered No. $\frac{1023}{1}$.

Family ANGUILLIDÆ.

Coloconger raniceps, Alcock.

Ann. Mag. Nat. Hist. (6), vol. iv, p. 456, (1889); *Illustr. Zool. "Investigator,"* Fishes, pl. vii, fig. 4 (1892).

Among many specimens of this species are three from Stations 323 and 333 which are of unusual size, being over 30 cm. in length. They are black in colour but otherwise resemble the smaller specimens of the species, which are greyish brown. The generative organs of these three specimens are conspicuously ripe. They are probably the sexually mature form of the species which, as in certain other eels, is different in appearance from the immature form. Registered No. $\frac{1090-2}{1}$.

Family SYNAPHOBRANCHIDÆ.

Synaphobranchus pinnatus, var. *brevidorsalis*, var. nov.

Illustr. Zool. "Investigator," Fishes, plate xlvii, fig. 1 (1909).

This variety closely resembles *S. pinnatus* in all but one character, namely, the length of the dorsal fin. In this it resembles *S. brevidorsalis*.

In describing the position of the dorsal fin the same words may be used as in the description of *S. brevidorsalis*: "The dorsal fin commences so far behind the vent that the distance between its origin from the vent equals the length of the head." (Günther.)

In its general proportions and in the mosaic-like arrangement of the elongated scales the specimen resembles *S. pinnatus* and differs from *brevidorsalis*.

There are three specimens of *S. pinnatus* from separate stations in the Arabian Sea. In all of these the dorsal fin arises about a head-length and a third behind the gill-opening; in this specimen it arises rather more than two head-lengths behind that point.

One specimen, 70 cm. in length, from the Arabian Sea, Station 338, 839 fathoms. Registered No. $\frac{11.4.1}{1}$.

Suborder **Heteromi.**

Family NOTACANTHIDÆ.

Notacanthus indicus, sp. nov.

Illustr. Zool. "Investigator," Fishes, plate xlv, fig. 8 (1909).

B. 12, D. xi, A. 14-105, V. iii 7, P. 12.

The length of the head is three-fifths of the distance between the snout and vent. The head is $4\frac{1}{4}$ in the total length. The depth of the body at the ventrals and pectorals is $7\frac{1}{2}$ in the total length.

The snout is pointed, laterally compressed, and half as long again as the eye. The diameter of the eye is $6\frac{1}{2}$ in the length of the head. The corner of the mouth lies just behind a vertical through the anterior border of the eye. Just above the corner of the mouth is a stout curved spine lying horizontally with the concavity downwards. The nostrils lie in front of the middle of the eye and are slightly nearer the eye than the end of the snout. The gill-covers are very large and form more than half the length of the head: widely open behind and above, they are united below for less than half their length.

The lateral line is conspicuous; it commences a short distance in front of the upper angle of the gill-opening. Behind the head it occupies the highest quarter of the body but descends gradually until it occupies the middle line of the tail. There are eleven spines in the dorsal fin, they become gradually longer from the first to the tenth; the eleventh is a small spine. The distance of the first spine from the end of snout is very nearly as long as the distance of the eleventh from the end of the tail. The vent lies under the third dorsal spine. The first ventral spine lies immediately behind the vent. The last ventral spine lies under the last dorsal. The ventral spines increase in length from before backwards.

The ventral fins contain three short spines and seven soft rays; they are partially joined together at the base. The pectorals reach to the base of the ventrals and are nearly as long as the postocular part of the head. They contain twelve soft rays. The scales are cycloid, small, and cover the whole body and head.

The premaxillæ on either side bear twenty-five curved teeth arranged with great regularity. The lower jaw contains forty-two teeth on either side. They are not so curved nor are they arranged with such regularity as the premaxillary teeth. There are forty-two similar teeth on the palatines, they evidently oppose the teeth of the lower jaw. Stomach siphonal. Four large pyloric cæca.

One specimen, 20 cm. in length. Colour dark brown. Arabian Sea, 512 fathoms, Station 305. Registered No. $\frac{10.1.9}{1}$.

Suborder **Percesoces.**

Family CHIASMODONTIDÆ.

Genus Kali, nov

A genus allied to *Chiasmodus* (Johnson), differing from it in the reduction of the operculum, in the character of the teeth, the presence of a double row of pores in the lateral line, and in possessing pyloric cæca.

The body is scaleless and covered with thin, loose, black skin. There are two separate dorsal fins, the anterior slightly shorter than the posterior which is equal and opposite to the anal. The ventrals are thoracic but slightly behind the level of the pectorals. The mouth is very wide. The opercular bones are much reduced so that the angle of the lower jaw forms the posterior limit of the head. The teeth are few and very large, with arrow-headed points; they are arranged in two series, those of the inner series being much the larger. The vomer is toothless; the palatine bears a few large teeth. Upper pharyngeal teeth are present. All the teeth are depressible inwards. The gill-aperture is very wide. There are four long slender gills with very short filaments. There are no pseudobranchiæ. The stomach is cæcal and very large. There are two pyloric cæca. Air-bladder present.

Kali indica, sp. nov.

Illustr. Zool. "Investigator," Fishes, plate xliv, fig. 5 (1909).

B. 6, D. xiii 22, A. 23, P. 12, V. i 15.

The head is a quarter of the total length without the caudal. The greatest depth, which is just in front of the attachment of the pectorals, is a fifth of the total. The length of the snout is equal to the interorbital breadth and half as long again as the diameter of the eye, which is a fifth of the length of the head. The mouth is very large and extends far behind the eye. The upper and lower jaws meet only at their articulations and in front; they curve upwards and downwards in the middle of their length. Because of this curve the teeth can stand erect. When the mouth is closed, the upper and lower jaws are separated in the middle of their length by a distance greater than the diameter of the eye. There is a deep bony depression on the top of the head limited by two ridges which converge and meet in the middle of the upper surface of the snout. On either side of these ridges are two deep depressions in the bone (the loose skin has become detached from the head in the single specimen). The openings of the gill-cavities are very large. The gill-coverings are completed below by a thin membrane which is so voluminous that in the dead specimen it is not rendered tense until the angles of the jaw have been separated laterally from one another by a distance equal to the length of the head. The gill-arches are very long and slender and are freely exposed. Their filaments are short, being equal to half the diameter of the eye. The teeth are alike in both jaws; they consist of an outer series of ten teeth increasing in size from behind forward—the largest being slightly less in

length than the diameter of the eye, and of an inner series of three much larger teeth the middle one of which is situated beneath the eye and is as long as the snout. All teeth are completely depressible except the foremost of the outer row which are only partially so. There are five long depressible teeth on each palatine. There are well-developed upper pharyngeal teeth. The vomers are toothless.

The vent is half-way between the snout and the root of the tail. The pectoral fins are nearly as long as the head. The ventrals arise below and behind the pectorals and are about half their length. The second dorsal and the anal fins commence at the level of the vent. The two dorsal fins are separated by a distance equal to the diameter of the eye. In the specimen the skin of the anterior half of the body alone is present. In this region the lateral line consists of a double series of circular white spots. There are eighteen pairs of these from the highest point of the gill-opening to the level of the vent. The stomach is cæcal and very large. It is empty and contracted but its walls are very thick, much folded and covered with tortuous blood-vessels. There are two pyloric cæca ascending on the left side of the stomach. An air-bladder is present.

Judging from the character of the jaws, teeth, gills and stomach, we may assume that this genus has, like *Chiasmodus*, the habit of swallowing large fish.

One specimen, 17 cm. in length. Bay of Bengal, Station 312, 1,343 fathoms. Registered No. $\frac{10.5.4.}{1}$.

Genus Dysalotus, MacGilchrist.

A genus allied to *Chiasmodus*, Johnson, differing from it in possessing four series of teeth in the jaws, and scales which are provided with thorn-like spines. It possesses a pseudobranch and pyloric cæca.

Dysalotus alcocki, MacGilchrist.

Ann. Mag. Nag. Hist. (7), vol. xv (1905), p. 268; *Illustr. Zool. "Investigator,"* Fishes, pl. xxxvii (1905).

B. 7, D. viii 27, A. 27, P. ii, V. i 5.

"The body is elongate and compressed; its height contained nearly eight times in the total length, without the caudal. The head is large, low, and long, contained about $3\frac{1}{2}$ times in the same standard length.

The snout is very long and depressed, about 3 times the diameter of the eye and more than $\frac{1}{3}$ the length of the head. The eyes are lateral, wide apart, small, and deep-set. The interorbital space is more than twice the diameter of the eye, nearly flat from side to side, and traversed by two anteriorly converging ridges which enclose a V-shaped space. The nostrils are slightly nearer to the eye than to the tip of the snout.

The mouth is very deeply cleft, reaching beyond the eyes. The lower jaw projects beyond the upper; no barbel. The mucous system of the head is well-developed.

The body is naked except the posterior half or so, which is furnished with (minute) spiny scales arranged for the most part in rows parallel to the lateral line; the spinules have a backward inclination.

The lateral line is single, uninterrupted, very broad, and conspicuous; it runs from the upper angle of the gill-opening to the base of the caudal, curved slightly downwards, and contains a row of about 41 distinct pores.

Two separate dorsal fins: the first begins slightly posterior to the vertical through the base of the pectoral, and contains 8 slender spines; the second begins a couple of millimetres behind the first, is much the longer, and contains 27 rays. The anal is equal, opposite and similar to the second dorsal. Caudal symmetrically forked. Pectorals long (about half the length of the head) and slender, in position nearer the ventral than the dorsal line; all rays branched. Ventrals (I, 5) short (not so long as snout), inserted below the pectorals, but connected only by ligament with the clavicular arch.

Vent about 8 mm. in front of where the anal fin begins. No anal papilla; small urogenital papilla behind the vent.

The jaws are distensible, with four series of setiform teeth similar in both jaws; those of the inner rows longest; all movable and turned inwards. No vomerine teeth; a single row of small teeth—depressible backwards—on each palatine. Tongue free. Gill-openings very wide, with membranes joined only quite anteriorly. Seven branchiostegals. Gills four; last gill-cleft a foramen merely. Branchial arches weak and gill-rakers represented by small fixed and fairly numerous teeth similar to those of the mouth. Pseudobranchiæ are present.

An air-bladder is present, but without an open duct. The pyloric cæca were densely matted together and entangled with parasitic worms; there were about nine cæca. Beside these the hepatic duct opened into the gut. Vertebræ 39 (15 abdominal and 24 caudal). Abdomen extends well behind the vent into the tail. The stomach is elongate, cæcal in shape, and empty; its inner surface presented large coarse, longitudinal rugæ. Liver small.

The colour in life was violet-black. A single specimen about $9\frac{1}{2}$ inches long; was caught in the trawl at Station 315, Bay of Bengal, near the Andamans, 705 fathoms." (MacGilchrist.) Registered No. $\frac{1053}{1}$.

I think that the word "minute" which is applied to the spiny scales should be omitted These structures are the most remarkable peculiarity of the genus. They are arranged in four irregular rows parallel to the lateral line in the posterior part of the body. Each spine arises from the centre of a circular disc which may measure over a millimetre in diameter; the spines are slender, transparent and upright, and curve slightly with the concavity directed backwards. Some of them project from the disc by as much as a millimetre.

The parasitic worms referred to have been since identified by Prof. von Linstow as immature examples of a species of *Ascaris*.

Family TETRAGONURIDÆ.

Genus Mulichthys, nov.

Resembles *Tetragonurus*, the only other genus of the family, in the form of the body and general arrangement of the fins and in possessing œsophageal sacs lined by

papillæ. Differs from *Tetragonurus* in that the soft dorsal and anal fins are continued nearly as far backwards as the caudal, the anal fin being preceded by three spines; in having only three branchiostegal rays; in being devoid of gill-raker-like knobs below the pseudobranchiæ.

The pectoral arch (text-fig. 2) is suspended from the skull; the coracoid is foraminate; there is no mesocoracoid; there are four metapterygials, the highest is nearly suppressed, the next two articulate with the scapula, the lowest and largest touches both scapula and coracoid. One or two of the uppermost rays of the pectoral fin articulate with the scapula; the postclavicle is well-developed, its lower end is close to but does not touch the hinder end of the pelvis.

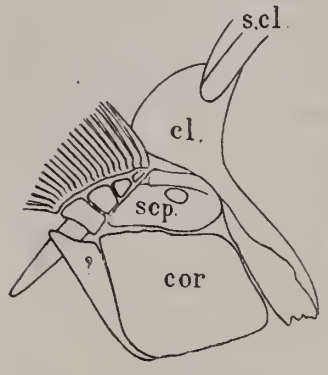


Fig. 2.—Shoulder-girdle of *Mulichthys*.

The eye rests upon a concave lamina of bone which projects inward from the suborbital. The maxilla does not make up any part of the margin of the jaw. The premaxilla and the dentary bear a single row of minute peg-like teeth which are set close together in the gum, but scarcely project beyond it and combine to form a weak cutting edge. There are a few small teeth on the vomer and palatines.

There are four gill-arches and a wide slit behind the fourth.

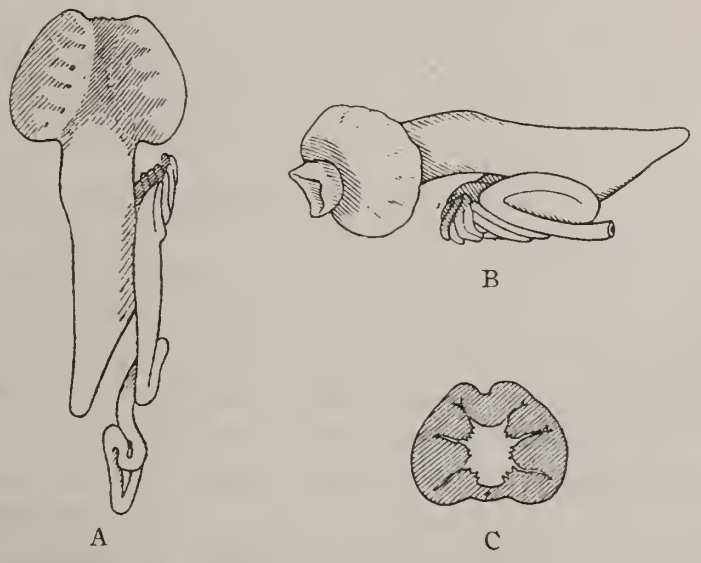


Fig. 3.—Viscera of *Mulichthys*: A, from above; B, from left side. C, transverse section of gizzard.

The pseudobranch is very well developed, consisting of twenty distinct folds. The œsophagus is dilated laterally, forming a kind of gizzard which is lined by a hard papillated membrane (text-fig. 3). There are numerous well-developed pyloric cæca. There is no air-bladder.

Mulichthys squamiceps, sp. nov.

Illustr. Zool. "Investigator," Fishes, plate xlvii, fig. 4 (1909).

B. 3, D. x 20, A. iii 20, P. 19, V. i 5, L.l. 53, L.tr. 15.

The head is slightly less than a third of the total without the caudal. The greatest depth of the body equals the length of the head. The diameter of the eye is one-third of the length of the head. In length the snout is two-thirds of the diameter of the eye; it is smoothly conical and somewhat pointed. The lower jaw falls short of the snout. The nostrils lie just below a horizontal line drawn through the upper border of the eye and half-way between the eye and snout. The vent is equidistant from the snout and the base of the tail. The body and head, including the cheeks and snout, must have been covered with scales which have since fallen off, judging from their areas of attachment; it is probable that the scales were approximately rhomboidal in shape. There are indications of two lateral lines as portrayed in the figure. (The scale areas have been represented somewhat conventionally in the figure.) The colour of the whole fish is chocolate-brown. It is probable that this fish is, like *Tetragonurus*, an inhabitant of the intermediate depths of the ocean.

One specimen, 11 cm. in length, taken in a trawl from the Arabian Sea, 512 fathoms, Station 305. Registered No. $\frac{1020}{1}$.

Family STROMATEIDÆ.

Psenes nigrescens, sp. nov.

Illustr. Zool. "Investigator," Fishes, plate xlvii, fig. 6 (1909).

B. 6, D. ix 22-25, A. iii 21-23, V. i 5, P. 21.

A small compressed fish with a blunt, rounded snout. The greatest height is slightly more than half the length without the caudal. The length of the head is $2\frac{3}{4}$ in the length without the caudal. The snout is about half the diameter of the eye. The diameter of the eye is a third of the length of the head. The length and depth of the head are about equal. The length of the upper jaw is equal to the diameter of the eye. The angle of the lower jaw reaches nearly as far back as a vertical through the centre of the eye. The pectoral fins are as long as the head behind the centre of the eye. The ventral fins arise vertically below the base of the pectorals and reach as far back as the first anal spine. The opercular margin above the pectoral fin shows two blunt points separated by a wide and open notch. The lateral line forms a wide curve. Scales cycloid. Colour dark greyish brown. Fins black, except the caudal, which has a little pigment and the pectorals, which have none. A single row of small teeth in both jaws. None on palatine or vomer. Many specimens were obtained in the trawl from 950 fathoms. Their stomachs contained *Sagitta* or some allied Chætognathous genus in large numbers, so they were not caught at the bottom. Judging from their uniform dark grey colour they were probably from the intermediate depths. Andaman Sea, Station 310. Registered Nos. $\frac{1038 \cdot 49}{1}$.

Suborder **Anacanthini.**

Family MACRURIDÆ.

Macrurus (*Cælorhynchus*) *acipenserinus* (Gilbert and Cramer).

Cœlocephalus acipenserinus, *Proc. U. S. N. M.*, vol. xix, page 422.

One specimen of this species, which has been recorded previously only from near the Hawaiian Isles. Bay of Bengal off Dondra Head, 620 fathoms, Station 321. Registered No. $\frac{1097}{1}$.

Suborder **Acanthopterygii.**

Division *PERCIFORMES.*

Family ACROPOMATIDÆ.

Synagrops splendens, sp. nov.

Illustr. Zool. "Investigator," Fishes, plate xlvii, fig. 5 (1909).

B. 7, D. ix-i-10, A. iii 8, P. 17, V. i 5, L.l. 53, L tr. 3-1-9.

The greatest depth, which is at the anterior end of the first dorsal, is $3\frac{1}{4}$ in the length without the caudal.

The length of the head is nearly half the total without the caudal, the proportion being 11 : 24.

The eye is large, it is a quarter the length of the head and is longer than the longest part of the interorbital space.

The mouth is oblique, the posterior end of the maxilla nearly reaches to a vertical through the centre of the eye.

The length of the snout is slightly less than the diameter of the eye. The lower jaw projects beyond the upper. The symphysis of the lower jaw is very prominent. The nostrils are in front of the upper half of the eye and are much nearer the eye than the end of the snout. The anterior of the two nostrils is the smaller and is placed at a lower level than the other. The posterior margin of the operculum has two thin flexible points, the upper one being the smaller. The lower is formed by a prolongation of the subopercular and is supported by a third somewhat stronger point, which is the true posterior angle of the opercular bone. The preoperculum has a double border but is not serrated.

There is a well-marked pseudobranch. The gill-rakers are numerous and flattened but not acutely pointed.

There are small villiform teeth on the premaxillæ, palatines and vomer. The teeth of the lower jaw are larger than those of the upper. There is a pair of large canine teeth in the upper jaw and a pair at the symphysis of the lower jaw.

The deciduous scales are very large and stout, they overlap one another by about three-quarters of their diameter, they are ctenoid, but some of the scales, especially those below the eye, have inconspicuous serrations or none at all.

The first dorsal fin commences behind the level of the pectoral fin and in front of the level of the opercular angle.

The first dorsal spine is half the length of the third which is the highest of all. The two dorsal fins are almost in contact. The pectoral fin reaches nearly as far back as the level of the first anal spine. The ventral fin arises at the same level as the pectoral but is only half its length. The vent lies between the ventral fins at the level of the opercular angle. There are three anal spines ; the first, which is very short, is opposite the middle of the posterior dorsal fin.

The caudal fin is deeply cleft and is as long as the postocular part of the head.

The lateral line is distinct ; it is curved and occupies the upper part of the body ; it is separated from the mid-dorsal line by three rows of scales.

Seven pyloric cæca of moderate length. Colour in spirits reddish brown above. Scales very bright and silvery with a fine blue iridescence.

One specimen, 15 cm. in length, from the Gulf of Oman, 230 fathoms, Station 341. Registered No. $\frac{11}{1}\frac{64}{}$

This species differs from *S. philippinensis* in possessing three anal spines. The preopercle and spine of the ventral fins are not serrated and the scales are ctenoid.

Divison *ZEORHOMBI.*

Family PLEURONECTIDÆ.

Samaris inornata, sp. nov.

Illustr. Zool. "Investigator," Fishes, plate xlvii, figs. 7, 7*a* (1909).

B. 6, D. 61, A. 48, P. 5, V. 5, C. 16.

The breadth of the body is $2\frac{1}{2}$ in the length without the caudal. The length of the head is $4\frac{1}{8}$ in the length without the caudal. The length of the snout is a little less than half the diameter of the eye. The eye is $3\frac{1}{2}$ in the length of the head.

The eyes are close together but not in contact; the right is very slightly in advance of the left. The pupil is semilunar, being reduced by a flap which descends from the upper margin of the iris. The anterior nostril on the coloured side is tubular, the posterior is simple.

The mouth is oblique, the right and left maxillæ are equally developed and are of the same length as the eye. The teeth are villiform and are arranged in a compressed band ; they are alike on both sides of the jaw. The arrangement is nearly the same as in *S. cristata* but differs in being compressed into one broad band instead of being arranged in distinct rows. There are no teeth on the vomer and palatines.

The right pectoral fin contains five rays and is longer than the head. There is no pectoral fin on the blind side. There are two ventral fins each with five rays. The right is pigmented and is one-third longer than the left which is unpigmented. The caudal fin is about one-fifth of the total length. The rays of the dorsal and anal fins become longer posteriorly. They are sharply marked off from the caudal fin. The dorsal fin commences well in front of the eye in one specimen; the first ray arises

close to the upper lip. There is no prolongation of the first dorsal rays. This constitutes the great distinction between this species and *S. cristata*.

The lateral line is straight, rising slightly in the anterior part of the body.

The gill-rakers are short tubercles.

Colour of the upper surface.—Chestnut-brown with diffused blotches of sepia and dark grey; white below.

Fins black.

Scales ctenoid on both sides; the cilia are much less marked on those of the lower side.

Three specimens, the longest measuring 13 cm., from 130 fathoms in the Gulf of Aden, Station 360. Registered Nos. $\frac{2\,4\,0\,1-3}{1}$.

This species so closely resembles *S. cristata* that it was thought that the absence of the crest might be due to the fact that these specimens were of the opposite sex to those on which *S. cristata* was defined. Examination of the immature generative organs show, however, that both sexes are represented among the three specimens.

Læops nigrescens, Lloyd.

Rec. Ind. Mus., vol. i, pt. i, p. 9 (1907); *Illustr. Zool. "Investigator,"* Fishes, pl. xliii, fig. 2 (1908).

D. 95, A. 82, C. 17, P.d. & 5. 13, V.d. & s. 6.

This species is closely allied to *L. guentheri* and *L. parviceps*. It differs from these in the following respects:—

It is bathybial in appearance. The pectoral fins are longer than the head. The head is $\frac{1}{4}$th the length without the caudal fin; the height without the fins is $2\frac{2}{3}$ in the total length. The pectoral fins are better developed on the left side; the length of the left pectoral is longer than the entire head in most specimens; it is never less than the length of the head. The left pectoral fin is much longer than the right, in some specimens nearly twice as long. The ventral fins are about equal: the left is in a line with the anal. The caudal fin is pointed, its length is 6 in the total The length of the dorsal and anal fin rays are about equal and are about $2\frac{1}{2}$ in the body height. The lateral line forms a strong pectoral curve; the scales are small and deciduous. The snout is half the major diameter of the eye, the lower eye is in advance of the upper; the eyes are separated by a prominent ridge.

The major diameter of the eye is one-third the length of the head.

Teeth on the blind side only.

Vomer prominent, devoid of teeth.

Six specimens, the longest $6\frac{3}{4}$ inches in length.

Colour.—Left side dark sepia, with irregular patches of a darker sooty tone, fins nearly black. The colour resembles that of *Læops macropthalmatus* from 100 fathoms and differs widely from that of *L. guentheri* and *L. parviceps* from shallow water.

Habitat.—Gulf of Aden, 130 fathoms, Station 360. Registered Nos. $\frac{1\,2\,9\,1-6}{1}$.

Division *SCLEROPAREI.*

Family SCORPÆNIDÆ.

Minous longipinnis, sp. nov.

Illustr. Zool. " Investigator," Fishes, plate xlvii, fig. 3 (1909).

B. 7, D. x 12, A. ii 10, P. i 10, V. i 5.

Resembles *M. inermis* but differs from it in the following respects :—

(1) The snout is longer than the eye ; proportion 3 : 2.
(2) The posterior end of the maxilla does not reach a vertical through the anterior border of the eye.
(3) The pectoral fin is considerably longer than the head and reaches to the base of the caudal.
(4) The spines on the head are in the same position as in *M. inermis*, but they are relatively stronger.
(5) The ventrals reach beyond the origin of the anal.
(6) Colour.—Upper half dark grey fading to light grey below. Edges of fins black. Pectoral and pelvic fins almost black.

The upper side of pelvic fins and the inner side of the pectoral fins have elongated white spots.

Two specimens, the longest 10 cm. in length, from the Gulf of Oman, 230 fathoms, Station 341. Registered Nos. $\frac{1158-9}{1}$.

Gymnapistus affinis, sp. nov.

Illustr. Zool. " Investigator," Fishes, plate xlvii, fig. 2 (1909).

B. 6, D. iii 8, A. iii 7, V. i 5, P. 15.

The head is somewhat longer than the greatest depth of the body and is slightly less than a third of the total length. The diameter of the eye is a third of the length of the head. The interorbital space is less than the diameter of the eye. The mouth is nearly horizontal. The lower jaw projects somewhat beyond the upper. The end of the maxilla is slightly behind a vertical through the centre of the eye. The length of the snout is three-quarters of the diameter of the eye. The nostrils are on a level with the lower border of the eye. The anterior or lower nostril is on a tubular papilla. The preorbital bone bears a strong spine which is as long as the snout and projects horizontally outwards and backwards. At its base is a much shorter spine directed forwards. In a line with this spine the preopercle also bears a strong spine projecting backwards. Below this are four other spines. The base of the preorbital and preopercular spines are connected by a blunt ridge ; the operculum bears three or four obscure spines. The first spine of the dorsal fin is on a level with the posterior border of the eye. The third and fourth spines are separated by a greater interval

than the others. The first spine is half the length of the second, the third is the longest of all. The first anal spine is opposite the eleventh dorsal.

The pectoral fins reach well beyond the vent and are as long as the head. The attachment of the pelvic fins is below that of the pectorals. The pelvic fins are two-thirds the length of the pectorals. The caudal fin is rounded; it is one-fifth of the total length. The lowest five rays of the pectoral fins are separate.

The body is covered with minute imbricate scales. The lateral line is nearly straight; it descends somewhat in the region of the tail.

The gill-rakers are short and obtuse.

The stomach is cæcal, with four short pyloric cæca. There are minute villiform teeth in both jaws and on the vomer and palatines.

Colour in spirits greyish brown above, lighter below. The dorsal, pectoral and caudal fins have obscure grey spots. There is a greyish blot behind the angle of the opercle. There are two irregular rows of spots above the lateral line.

Several specimens, the longest 9 cm. long, from Station 329 in the Gulf of Martaban, 46 fathoms. Registered Nos. $\frac{1172}{1}$-$\frac{1178}{1}$.

A species closely allied to *G. niger*.

Family CLYCOPTERIDÆ.

Genus Liparoides, nov.

A small tadpole-like fish which shows its relation to the family in possessing a sub-orbital stay to the preoperculum and a broad attachment of the pectoral fins. It differs from the other bathybial genera of the family in possessing a diphycercal tail and small pelvic fins which are not modified into a sucker. There is one continuous dorsal fin, but the anterior rays differ from the posterior. The dorsal and anal fins are separated from the caudal by a wide space. The line of attachment of the pectoral fin rays is about as long as the longest ray. The rays diminish in length from above downwards. The pelvic fins are small and are situated close together near the middle line between the lowest ray of the pectorals. The vent is situated about the middle of the body length. The gill-openings are wide, extending from the upper angle of the operculum to the lower end of the attachment of the pectoral fins. Branchiostegals seven. Three-and-a-half gills; no slit behind the fourth arch. A small pseudobranch.

Teeth in two or three irregular series in both jaws and on the vomer and palatines. Skin soft, grey and devoid of scales. Large mucous glands open on the head. Eyes are most probably functionless.

Liparoides beauchampi, sp. nov.

Illustr. Zool. "Investigator," Fishes, plate xlv, fig. 3 (1909).

B. 7, D. vi 16, A. 12, P. 23, V. 4, C. 15.

The head is rather less than half the total length without the caudal, the proportion being five to eleven. The greatest breadth of the head is equal to two-thirds of

its length. The greatest depth, which is at the occiput, is slightly less than the greatest breadth. The vent is half-way between the snout and the root of the tail.

The first dorsal ray arises at the level of the upper end of the gill-openings. The first six rays are short, delicate and flexible but not articulate. The posterior sixteen rays are longer, stouter and articulate. The dorsal and anal fins are separated from the caudal by an interval which is equal to a quarter of the length of the head. The twenty-three pectoral rays are attached along a line opposite the lower half of the gill-openings. The uppermost and longest rays are equal to the post-orbital part of the head. The pelvic rays are about half that length. The caudal fin is about one-fifth of the total. One specimen measuring 55 mm. from 643 fathoms in the Bay of Bengal, Station 372. In the fresh state the fish seems to be blind, both orbits being covered by opaque skin, but on the right side the eye-ball could be seen through the skin, though not on the left. On dissection it was found that the right orbit contained a well-developed eye but that the left contained a small rudiment. The specimen did not appear to be damaged in any way.

Fig. 4.—*Liparoides beauchampi*, sp. nov., ventral surface.

Named after Commander W. G. Beauchamp, R.I.M., Commanding Officer of the "Investigator." Registered No. $\frac{2377}{1}$.

The pectoral and pelvic fins of this specimen so closely resembled those of *Paraliparis latifrons* as figured by Garman (*Memoirs Mus. Comp. Zool. Harvard*, xxvi, pls. xxvii and xxviii), that it was first thought that the pelvic fins must be merely the lowest detached rays of the pectoral arch as in that species, and not true pelvic fins. Dissection, however, showed that well-developed pelvic bones were present, the anterior ends of which were in contact with the lower ends of the pectoral arch, and the four pelvic filaments were clearly attached to these pelvic bones (text-fig. 5). It is probable that the four detached rays of *Paraliparis* were originally pelvic rays which acquired a secondary attachment to the pectoral arch during the reduction of the pelvis to its rudimentary condition.

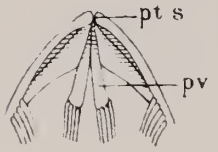


Fig. 5. — Limb girdles of *L. beauchampi*.
pv. = pelvic.
pt. = pectoral.

Family TRIGLIDÆ.

Peristethus adeni, Lloyd.

Rec. Ind. Mus., vol. i, part i, p. 8 (1907); *Illustr. Zool. "Investigator,"* Fishes, pl. xliii, figs. 1, 1*a* (1908).

B. 7, a.D. 7, p.D. 14, V. 5, P. 12 2, L.l. 24, L.tr. 4, A. 14.

The length of the preorbital process is equal to one-third of the distance between its extremity and the anterior border of the orbit. The preocular ridge has a prominent, finely serrated border; it ends behind in a sharp spine, which is nearly as long as the eye. The inner borders of the preorbital processes are parallel, their outer

borders, if prolonged, would meet in front at an angle of 40°. The preorbital processes therefore appear to converge. The length of each labial tentacle is equal to the width of the mouth.

The osseous plates between the ventral fins are unusually thick. The greatest length of each anterior ventral plate is equal to the greatest breadth of both combined. The greatest length of the posterior ventral plates is half that of the anterior ones. The greatest length, in both cases, is to one side of the middle line. A quadrangular portion of the posterior plates fits into a corresponding hiatus in the anterior plates. Throughout the length of the body, on either side, there are four rows of plates, each with a large spine shaped somewhat like a rose-thorn, their points curving backwards. The lowest row is much less conspicuous than the others.

There are large postorbital, occipital, post-temporal, and two opercular spines, a small upper and a large lower one, on either side. There is one small median spine, an orbit's length in front of the orbits.

The greatest height is one-fifth the total length. Total length of the single specimen $6\frac{1}{2}$ inches; greatest length of the head 3 inches.

Colour.—Reddish yellow, pectorals grey, dorsals tipped with black.

Habitat.—Gulf of Aden, 130 fathoms, Station 360. Registered No. $\frac{1443}{1}$.

Division JUGULARES.

Family ZOARCIDÆ.

Diplacanthopoma squamiceps, Lloyd.

Rec. Ind. Mus., vol. i, part i, p. 10 (1907); *Illustr. Zool. "Investigator,"* Fishes, pl. xlii, fig. (1908).

Corresponds with the generic definition in the following respects:—the form and arrangement of the fins, of the teeth and the gills, in the number of the branchiostegals (8), in the absence of pseudobranchiæ and pyloric cæca, in the obscurity of the lateral line, and in the presence of radiating spines on the opercles. It differs from all known species in this important respect:—there are scales on the head as far forward as the posterior limit of the eyes and on the opercles and sides of the head as far forward as a line dropped vertically from the posterior border of the eyes. The head is much depressed and the eyes are close together and look upwards to a great extent, being separated by less than their diameter; this gives the head a very different appearance from that of the other three known Indian species of the genus, in all of which the eyes are separated by about $1\frac{3}{4}$ times their diameter.

There are deep mucus pits on the head and in a semicircle below the orbits.

There are no pseudobranchiæ, but in the position of these organs there are two very short and slender filaments which are vestiges of this organ. I find that the type specimens of *D. riversandersoni* and *D. raniceps* have precisely similar vestiges. This seems to be a strong argument for including this new species under the genus *Diplacanthopoma*.

The length of the head is $3\frac{1}{2}$ in the total without the caudal fin.
The greatest height is one-sixth the length without the caudal fin.
The length of the eyes is a little less than the length of the snout.
There are 19 rays in the pectoral fins.
The filaments composing the ventral fins are composed of two rays.
The male has a well-developed penis.
Two specimens, a male and a female, both about five inches long.
Habitat.—Off the S.-E. coast of Arabia, 540 fathoms, Station 361. Registered Nos. $\frac{13\,2\,1}{1}$ $\frac{2}{}$.

Barathronus diaphanus, Brauer.

Wissen. Ergebn. Deutsch. Tiefsee-Exped. "Valdivia," Bd. xv, part i, p. 305 (1906).

One specimen from Station 310, in the Andaman Sea, 960 fathoms. The "Valdivia" obtained this species from the Indian Ocean near the Chagos group in 2,919 metres. Registered No. $\frac{1\,0\,5\,0}{1}$.

Suborder **Pediculati**.

Family LOPHIIDÆ.

Lophius triradiatus, sp. nov.

Illustr. Zool. "Investigator," Fishes, plates xlv, figs. 5, 5*a* (1909).

B. 6, D. iii 8, A. 7, C. 8, P. 15, V. i 5.

The disk is elliptical, its length measured from the symphysis of the lower jaw to the base of the pectoral fins is half the total with the caudal. The height of the disk is half its length. The greatest breadth of the disk is rather more than half its length. The margins of the disk are scantily fringed. The diameter of the eye is equal to the interorbital space in the middle of its length and slightly less than the snout. The interorbital space is twice as broad behind as it is in front. The first two dorsal spines are on the snout: they are relatively small, the first, which is the longer, being about a third the length of the disk; it curves forward—it has been shown as straight in the figure, but bears no tassel (? incomplete); the second is a straight bristle, slightly shorter than the first. The third spine, which is about as long as the second, but somewhat stouter than either of the others, arises from the central and highest point of the disk. There is no trace of any other spines, subcutaneous or otherwise, between this and the soft dorsal.

The bony spines are relatively large, prominent and upright, two on each supra-orbital margin, two behind each eye, a small pair on either side of the snout. The humeral spine is feebly trifid.

The pectoral fins are a fifth of the total length. The caudal is a third of the total. The ventrals are nearly as long as the pectoral, but for two-thirds of the length they are fastened down to the body by a triangular fold of skin.

Depressible teeth in both jaws in three irregular series. Three or four teeth situated transversely in each vomer and the same number in each palatine.

Colour in spirits uniform grey above and below; lighter near the jaws. Three gill-arches without rakers; pseudobranchs present.

One specimen, 55 mm. in length, from the Laccadive Sea, Station 259, depth 300 fathoms. Registered No. $\frac{8.7.8.}{1}$.

Family CERATIIDÆ.

Genus Lophodolos, nov.

A genus which resembles *Dolopichthys* and differs from the other genera of the family in possessing paired cephalic spines and a jointed bait-bearing filament which is directed backwards, and in being covered loosely with soft black skin entirely devoid of scales and ossicles.

It differs from *Dolopichthys* in that the snout is short and the mouth nearly vertical, and in the position of the dorsal filament, which is attached to the back of the neck and not to the snout. The cephalic spines are disposed as in *Dolopichthys*. There are no ventral fins; the eye is very small; there are six branchiostegal rays and three gill-arches of which only the second and third bear filaments.

Lophodolos indicus, sp. nov.

Illustr. Zool. "Investigator," Fishes, plate xlv, fig. 7 (1909).

B. 6, D. 7, A. 6, P. 16, C. 11.

The length and depth of the head are about equal and are slightly less than half the total length without the caudal, the proportion being 4 : 9. The eye is very small and the snout is considerably shorter than the postocular portion of the head, the proportion being 2 : 3. The angle of the mouth is slightly in front of a vertical through the eye. The mouth is more nearly vertical than horizontal. There is a deep longitudinal groove on the cranium from the snout to the occiput. The cephalic spines are long and project upwards, outwards and slightly backwards. The nasal spines are much shorter and project directly upwards. The spines at the angle of the jaw seem to project downwards, outwards and forwards, but this part of the specimen is somewhat damaged. The spines on the mentum project directly forwards when the mouth is closed. They are curved, the concavity being below.

The depth of the body at the anterior end of the dorsal fin is about half that of the head. The whole is covered with a soft skin which is easily detached but not fragile.

The dorsal filament arises behind the occiput half-way between the snout and the fourth ray of the posterior dorsal fin. It is naturally directed backwards and reaches just beyond the base of the caudal fin. The proximal quarter is thick, the distal three-quarters is filamentous. The thick part has a backwardly directed joint close to its insertion. The bait is hard but is covered with short, shreddy filaments. Its

distal half is of a light colour. The gill-openings are of a moderate size and are situated just below the pectoral fins.

The branchiostegal rays are six in number arranged in an upper and lower set of three each, with a wide space between. There are three free gill-arches but the first bears no filaments. There is a fourth gill-arch incorporated in the pharynx wall which bears filaments on its outer side. There are no gill-rakers and no pseudobranch.

The upper jaw bears an irregular series of small teeth, the lower jaw a similar series of larger teeth. The teeth are depressible inwards. There are seven large pterygoid teeth on either side close to the opening of the gullet. Colour black throughout.

One specimen, 65 mm. long, from 888 fathoms, off the Travancore coast, Station 307. Registered No. $\frac{1}{1}\frac{0}{0}\frac{2}{2}\frac{4}{4}$.

Melanocœtus, sp.

Illustr. Zool. "*Investigator*," Fishes, plate xlv, fig. 4 (1909).

There is a small specimen of this genus which differs from other known species in several important respects. Although the specimen is complete, it is somewhat distorted and it is difficult to be sure of the appearance it would present during life. Its most striking peculiarity is the apparent absence of the anal fin; dissection shows that there were four rays in the position of this fin which were apparently subcutaneous, lying parallel with the lowest ray of the caudal fin. Of the presence of these rays there is no doubt, but one cannot be sure how far they would be erected during life. Another peculiarity is the form of the abdomen, which is much compressed and extends backwards beneath the caudal fin, encroaching on the space which is occupied by the anal fin in other species of the genus. The teeth are of unusual length; there are about fifteen on either side in the upper jaw and twelve in the lower jaw. The longest tooth is more than half the length of the lower jaw. The vomer forms a prominent transverse ridge bearing a long median tooth accompanied by four others, two on either side. The proportions cannot be given with certainty as the eye and pectoral fin on one side are considerably higher than on the other; this is evidently the result of artificial distortion.

One specimen measuring 20 mm. from the Arabian Sea, 947 fathoms, Station 184. Registered No. $\frac{2}{1}\frac{3}{7}\frac{7}{3}\frac{3}{3}$.

Family MALTHIDÆ.

Dibranchus nudiventer, sp. nov.

Illustr. Zool. "*Investigator*," Fishes, plate xlv, fig. 2. (1909).

Resembling *D. nasutus*, Alcock, but differing in that the lower surface of the disk and tail is devoid of spines.

The distance between the snout and the gill-opening is hardly greater than the distance between the gill-opening and the root of the tail, and is equal to the greatest

breadth of the disk. The snout projects beyond the mouth, though, to a somewhat less extent than in *D. nasutus*. The nasal tentacle, however, is exactly as in that species; it "ends in a pair of fleshy balls with a pair of filaments above and between them."

The diameter of the eye is about $\frac{1}{7}$th of the length of the disk. The eyes are rather more than a diameter apart. The caudal and pectoral fins are about equal in length and are one-fifth of the total length.

Up to this point the description is almost the same as that of *D. nasutus*. The only difference is in the dermal armature. The upper surface is covered with sharp spines on a stellate base. They are larger and less numerous that in *D. nasutus*. The ventral surface of the tail and disk is covered with smooth skin entirely devoid of spines except for three minute spines near the bases of the pelvic fins.

Colour dark grey. One specimen, 75 mm. in length, from the Bay of Bengal, off Arakan, 1,100 fathoms, Station 326. Registered No. $\frac{11.2.7}{1}$.

Malthopsis triangularis, sp. nov.

Illustr. Zool. "Investigator," Fishes, plate xlv, figs. 1, 1*a* (1909).

B. 5, D. 5, V. 2-3, C. 9.

The greatest breadth measured between the subopercular spines is slightly less than the greatest length excluding the caudal fin (proportion 9 to 10). The antero-lateral borders of the disk are straight and together form a right angle. The nasal spine is nearly vertical and is slightly more than half the diameter of the eye in length. The caudal and pectoral fins are of the same length and are longer than the pelvic fins in the proportion of 3 to 2. The caudal fin is slightly less than a fifth of the total length. There are seven large ossicles between the base of the ventral fins and the vent. One of these is large and central and is surrounded by the six others which are in contact with it. There is a pair of plates between the bases of the pelvic fins and five plates in front of them. The upper surface is covered with stellate ossicles except on either side of the middle line where there is an area of naked skin. This is bounded externally by an oblique row of ossicles which converge in the direction of the root of the tail. The subopercular spines are as large as the nasal spine and bear four transparent spinelets.

There are two gills; teeth are present on the vomer and palatines as in other species of the genus.

Two specimens from 279 fathoms in the Andaman Sea, Station 332. Registered Nos. $\frac{11.2.1}{1}$, $\frac{11.2.5}{1}$.

Family ANTENNARIIDÆ.

Chaunax apus, sp. nov.

Illustr. Zool. "Investigator," Fishes, plate xlv, fig. 6 (1909).

Resembling *Chaunax pictus* (Lowe) in every respect except that the pelvic fins and the nasal tentacle are represented by minute rudiments. Colour as in *C. pictus*.

There are numerous specimens of *C. pictus* among the collection made by the "Investigator." In all of these the pelvic fin and nasal tentacles though small do not vary much. Text-figure 6 shows the difference between the pelvic fins of equal-sized specimens of *C. apus* and *C. pictus*.

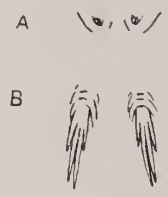


Fig. 6.—Pelvic fins of—
A, *Chaunax apus*, sp.nov.
B, *C. pictus* (Lowe).

One specimen, 11 cm. in length, colour reddish yellow. Bay of Bengal off Akyab, 530 fathoms, Station 379. Registered No. $\frac{2 \pm 0 \pm}{1}$.

II. SUPPOSED EVIDENCE OF MUTATION IN *MALTHOPSIS*.

Among the collection made by the "Investigator" are four small communities of pediculate fish of the genus *Malthopsis*, from separate but not far distant stations in the Andaman Sea.

It has been the custom in the Indian Museum to regard these four communities as of one species—*M. lutea*—although the individuals are so variable that if certain of them had been found alone in separate localities they would have been regarded without doubt as distinct species. However, they have been looked upon as one species, partly because each group was taken at one cast of the trawl in similar circumstances, every individual being of the same remarkable yellowish pink colour; but the fact that individuals of a particular and constant type occurred in the first three communities obtained, was probably the chief reason for regarding the whole collection as one species. This particular type predominated in the first community and it was described and figured as the type of the species. It was at first thought that the great variation shown by some members of the first community was due to the fact that they were immature. It was subsequently made clear, when the other communities were obtained, that the characters which were at first thought to be due to immaturity, occurred in some adult forms. There are twenty-one specimens in all and it will be shown that there are five distinct types among them not linked by intermediate forms. The four communities will be designated by the letters A, B, C and D, the five types by the letters v, w, x, y and z. The types are distributed in the following way; the figures indicate the numbers of individuals of each type:—

Community	A	contains	2 v, 2 w, x.
,,	B	,,	v, 6 w.
,,	C	,,	v, w, 2 y.
,,	D	,,	3 w, 2 z.

Type v occurs in three of the communities, while w occurs in all four. A specimen of type v was figured as *M. lutea*, for this type predominated in community A, which was the first to be obtained, and from which the genus and species were defined.

Two years ago I drew up a description of the type z under the name *Malthopsis triangularis*. There is no doubt that this type, of which there are two specimens, is remarkably different from the type v. The description is published here (*antea*) for the first time, though it seems that the other types w, x and y have almost as good a claim to specific rank.

Description of the Types.

In their gross structure the twenty-one specimens resemble one another and conform to the original description of the genus; they differ from one another in two respects, firstly, in the breadth of the disk; secondly, in the form and arrangement of the dermal ossicles. The variation in the breadth can be studied by measurement. The length of each specimen was measured from the snout to the base of the tail fin.

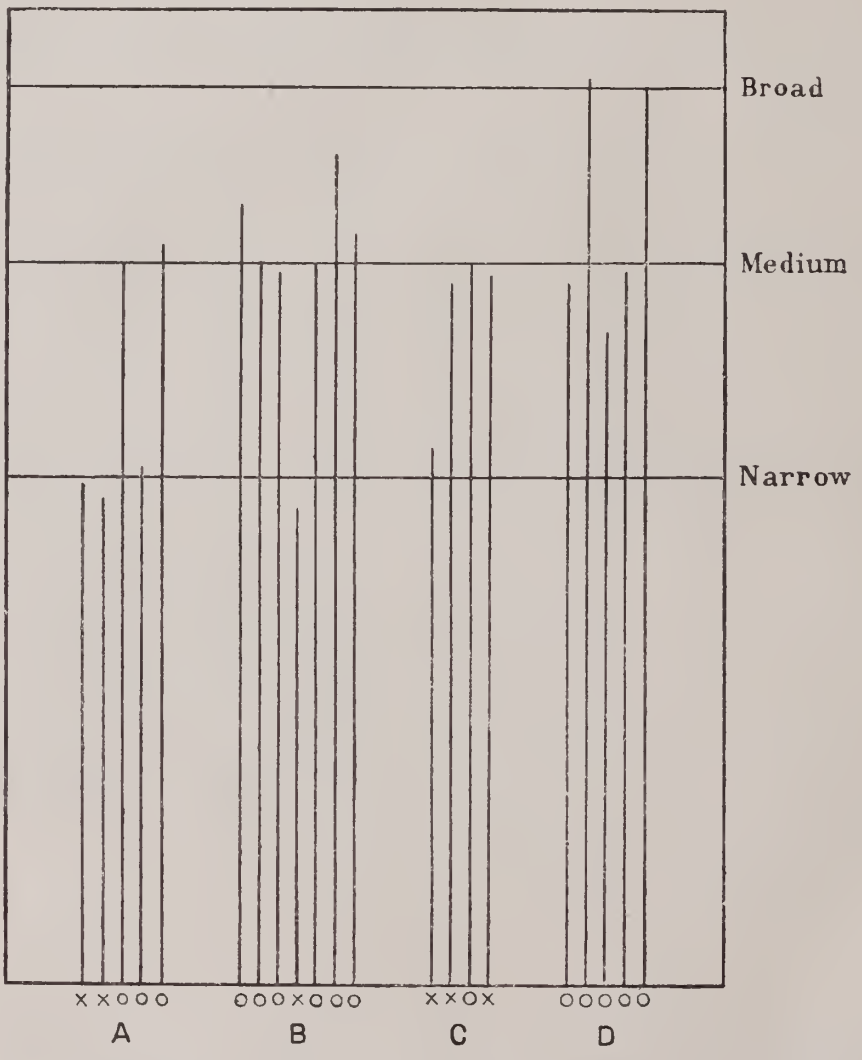


Fig. 7.—Proportion of breadth to length in 21 specimens of *Malthopsis* of communities A, B, C and D: O = orderly, × = disorderly.

The greatest breadth of the body was recorded as the distance between the most prominent parts of the subopercular spines. Measurements were taken to the nearest half-millimetre. The measurements are shown in the table at p. 176. The breadths are also displayed as percentages of the lengths by lines of proportionate length in text-fig. 7. This diagram shows that as regards breadth the specimens fall into three groups, the members of which may be spoken of as narrow, medium

and broad. If some hundreds of specimens had been available for measurement, there is no doubt that these three groups would have been bridged by intermediate forms, but they are so distinct that it seems certain that specimens approximating to the three types would be in excess however many specimens were measured.

The Dermal Ossicles.

Owing to the smallness in numbers some doubt may possibly be felt as to whether the above threefold division is justified. An examination of the dermal ossicles, however, shows a result which may be stated without doubt. As regards the arrangement of these ossicles the twenty-one specimens fall into two groups, which are perfectly distinct from one another. There are two distinct types in the arrangement of the ossicles, which will be spoken of as the "type of order" and the "type of disorder."

Each specimen possesses three particular spines,—a median nasal spine and two subopercular spines, one at each posterior angle of the disk. It was first noticed that whereas the nasal spine did not vary much in size or form among the whole group, the subopercular spines varied to a remarkable extent. The nasal spine is simple and conical, it was measured in each case by placing one end of the callipers in the little tentacular pit which undermines the spine, the other on the tip of the spine. The measurement so obtained was compared with the diameter of the eye. It was found that in every case the length of the spine was about half that diameter. Though constant in length this spine varies considerably in its position, being nearly upright in some while in others it is directed forwards.

The subopercular spines, however, vary to an extraordinary extent in size and form. They were studied in the following way:—The right spine of each specimen was placed beneath the microscope, magnified 50 times and its outline drawn with the camera lucida. The resulting figures reduced in size are shown on plate 1. It was found that these spines were in one of two conditions; they were either small, relative to the size of the fish, and covered irregularly with short projections, or they were large and armed with four long transparent spinelets disposed in a particular order constantly occupying the positions indicated by the terms antero-superior, antero-inferior, postero-superior, postero-inferior. The antero-superior spinelet is much the largest and is directed forwards; it is marked 1 in the figures. The postero-superior spinelet is generally curved upwards like a cow's horn; it is marked 2 in the figures, which do not show the curvature satisfactorily. Thirteen of the specimens in the collection possess these relatively large tetrafid subopercular spines, while the other eight have relatively small and irregular spines.

It has been mentioned that as regards the dermal ossicles, there are two distinct types in the collection, the orderly and the disorderly type. The presence of a large tetrafid subopercular spine is an important part of the orderly character. In every specimen possessing a small irregular subopercular spine the dermal ossicles of both dorsal and ventral surfaces are distributed in a disorderly manner. In every

specimen in which this spine is large and tetrafid the ossicles are arranged in a definite pattern. The full characters may be defined in the following way:—

Character.	Dermal order.	Dermal disorder.
1*st part*—Subopercular spine.	Relatively large and tetrafid.	Relatively small and irregular.
2*nd part*—Ventral surface of disk.	The space between the pelvic fin and the vent is occupied by seven large plates, a central one surrounded by the six others. The plates are in contact.	The space between the pelvic fins and vent is covered with about thirty minute plates which are widely separated from one another by naked skin.
3*rd part*—Dorsal surface of disk.	On the dorsal surface is a median row of four or five large plates.	
	On either side of the median row is an area of naked skin which is bounded externally by an oblique row of plates converging in the direction of the base of the tail.	There is no area of naked skin on either side of the median row; the whole dorsum is covered irregularly with plates.

Thus the character may be divided into three parts. Of these the first is nearly constant, the second is constant, but the third is less constant. The aberration shown by those individuals which are not quite true to type is always in the direction of the opposite character. For example, we shall see in dealing with the types and individuals, that among those which possess small irregular subopercular spines some show a slight tendency in the direction of the tetrafid type.

The contrast between the ventral surfaces of the two opposite types is most striking to the eye and is clearly visible in the photograph. It may be described at greater length. In the orderly type besides the seven plates already mentioned there is a pair of large plates between the bases of the pelvic fins. In front of these are six other plates, a large central one surrounded by five others. In the disorderly type these plates are represented by numerous small platelets distant from one another and arranged irregularly. Beneath the lower jaw of all the specimens is a semilunar area covered with little pits containing minute tentacles. In the orderly type this area is marked off from the rest of the disk by a row of four large plates, which are in contact with one another. In the other type these plates are absent; in one or two cases, however, they are represented by four minute platelets widely separated by naked skin, which are only visible with the aid of a lens.

Although there are two types of dermal armature, the orderly and disorderly, we have seen that there are three types of disk, a narrow, a medium and a broad. The characters occur independently of one another so that six types of fish are possible—

1. Orderly and narrow .. .. .. Type x.
2. Orderly and medium .. .. .. ,, w.
3. Orderly and broad .. .. .. ,, z (*M. triangularis*).
4. Disorderly and narrow .. .. ,, v (*M. lutea*).

5. Disorderly and medium .. .. Type y.
6. Disorderly and broad.

Of these six possible types no less than five are present in the collection. The only one not represented is the broad disorderly type.

Description of Types and Individuals.

The types z and v are most unlike one another and will be described first.

Type v (*disorderly and narrow*)—

This is the species *M. lutea* in the strict sense. It occurs in three of the communities and will be found in the plate under the designation A 1, 2; B 4; C 1. The four specimens resemble one another very closely. A 1 shows a tendency, however, towards the opposite type in one respect. The ventral surface in front of the pelvic fins, although covered with many platelets, shows one plate which is larger than the others and is surrounded by five others. Behind the ventral fins, however, the arrangement is quite disorderly. B 4 also shows a similar tendency. The subopercular spines of A 2 and B 4 show some approach to the tetrafid type which is part of the orderly character. B 1 and C 1, although occurring in different communities, show obscure pigmented rings on the upper surface, such as happens to come out well in the photograph of C 4, on the right side of middle line.

Type z (*orderly and broad*)—

This type has been described as *M. triangularis*. There are two specimens, D 2 and 5, occurring in the same community. The plate shows clearly that in the ordinary acceptance of the word these two individuals are of a different species from *M. lutea*.

Type x (*orderly and narrow*)—

This is represented by the single small specimen A 4, one of the most interesting fish in the collection. It can be seen that the disk is of exactly the same shape as that of *M. lutea*, while the plates are arranged as in *M. triangularis*. Although it is much smaller than any of the five specimens of type v, its subopercular spine is actually larger than in some of the members of that type, and is perfectly tetrafid.

Although this fish is probably immature, there is no more reason for supposing that it would lose the orderly arrangement of its ossicles and retain its shape and so grow into a *M. lutea* than there is for supposing that it would retain the pattern and lose its shape and become *M. triangularis*.

Type y (*medium and disorderly*)—

This is represented by two individuals, C 2 and C 4, occurring in the same community. The shape of the disk is not quite the same, though both have departed from the narrow type. As regards the upper surface of the disk they approach the orderly type. On either side of the mid-dorsal row of plates is an area of skin covered with a few small scattered platelets. The postero-lateral spines also show a slight tendency towards the tetrafid type, that is, in the direction of the orderly

character. The plates of the ventral surface, however, show no sign of order. In both specimens there is a pigmented ring on either side of the mid-dorsal line; this is very plain in C 4. These rings also occur in the type v; they therefore seem to be a constant part of the disorderly character.

Type w (*medium and orderly*)—

Fish of this kind occur in every community—A 3, 5; B 1, 2, 3, 5, 6, 7; C 3; D 1, 3, 4. There is some variation in the breadth of the disk. B 5 approaches the broad type, and D 3 approaches the narrow type in this respect. The separation of the groups according to the shape of the disk is therefore not quite distinct, and yet one cannot believe that if a large collection were available they would be evenly distributed about a single mean as regards their breadth. Moreover, after considering the diagram (text-fig. 7) it can scarcely be doubted that there would be three means.

Measurements in millimetres.

Community.	Specimen.	Length.	Breadth.	B. / L.	Nasal spine.	Eye.	S. / E.
A							
Depth 200 fms.	A 1. 13014	49	25	51	4	8	50
Lat. 11° 31′ 40″ N.	A 2. 13015	50	25	50	4	8	50
Long. 92° 46′ 40″ E.	A 3. 13018	29	21·5	74	2·5	5	50
Green mud, 56 F.	A 4. 13016	27·5	14·5	53	2·5	4·5	55
Year 1890	A 5. 13020	27	20·5	76	2·5	5	50
B							
Depth 405 fms.	B 1. 134	35	28	80	3·5	6	57
Lat. 13° 27′ 00″ N.	B 2. 132	40	29·5	74	4	7	57
Long. 93° 14′ 30″ E.	B 3. 135	36·5	26·5	73	4	7	57
Green mud, 48 F.	B 4. 129	58·5	28·5	49	4·5	9	50
Year 1896	B 6. 130	39	29	74	4	7	57
	B 5. 131	38	32·5	85	3·5	6	57
	B 7. 133	37	28·5	77	4	7	57
C							
Depth 185 fms.	C 1. 286	65	36	55	5	10	50
Lat. 13° 17′ 15″ N.	C 2. 290	43	31	72	3·5	7	50
Long. 93° 10′ 25″ E.	C 3. 289	27	20	74	2·5	5	50
Sand, 53 F.	C 4. 288	39	28·5	73	3·5	6	57
Year 1897							
D							
Depth 279 fms.	D 1. 1123	40	29	72	4	7·5	53
Lat. 10° 21′ 00″ N.	D 2. 1121	42	39	93	4·5	8	56
Long. 92° 46′ 15″ E.	D 3. 1124	36	24	67	3·5	7	50
Green mud, 40 F.	D 4. 1122	34·5	26	75	4	7	57
Year 1904	D 5. 1125	37	34	92	4	7	57

The relation between the length of the nasal spine and the diameter of the eye is not expressed exactly by the above measurements which merely show that the spine is about half the diameter of the eye in every specimen. It was not possible to employ a smaller unit of measurement than half a millimetre with any confidence.

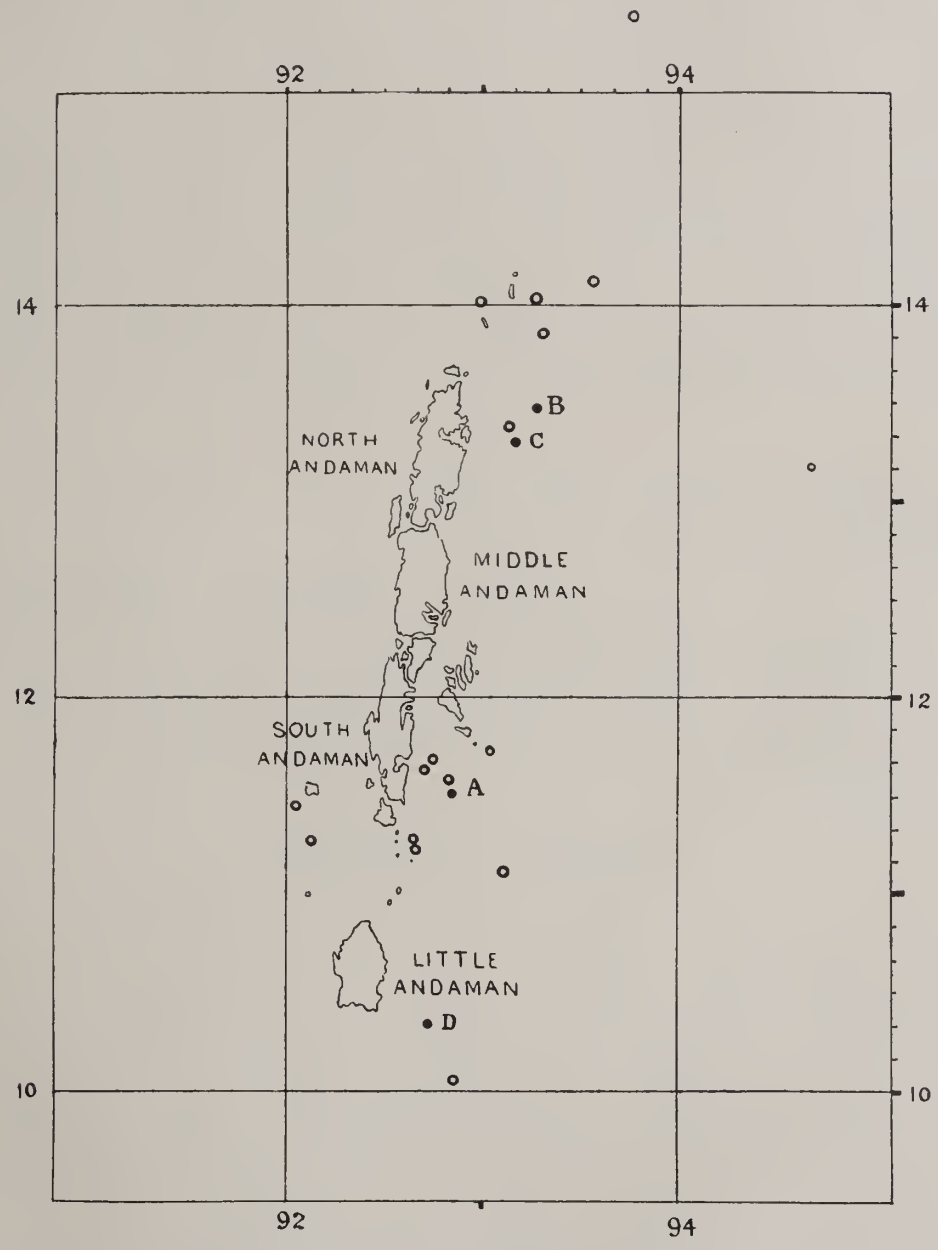


Fig. 8.—Map of Andaman Islands showing position of the four stations at which specimens of *Malthopsis* were obtained.

This list does not include all specimens that were caught. At Station A ten specimens were taken; some of these have passed out of the Indian Museum. It would be of great interest to know if any of these cannot be placed naturally in one of the five types. The specimens at present are in the following Institutions: the

British Museum, Oxford University Museum, Cambridge University Museum, United States National Museum and the Aberdeen University Museum.

Before considering the theoretical aspects of the case the following facts must be emphasised:—

1. The "Investigator" has trawled 380 times in the deep waters of the Arabian Sea and the Bay of Bengal. Twenty-one of these Stations were in water between 100 and 500 fathoms, in the neighbourhood of the Andaman Isles,— that is to say, in situations where we should expect to obtain *Malthopsis*.

2. Only four of the twenty-one Stations have yielded *Malthopsis*. Some of the localities are separated by considerable distances though all are in the neighbourhood of the Andamans. The position of the Stations is given on the map (text-fig. 8).

3. The smallest number of specimens obtained at one Station is four (community C); the largest number is ten (community A). The genus is therefore not rare at the Stations at which it was obtained, but it is not generally common in the moderate depths of the Andaman Sea, for not a single specimen was obtained at the seventeen other Stations, nor has it ever been obtained elsewhere by the "Investigator."

4. The physical conditions under which the four communities live must be remarkably similar.

5. The genus *Malthopsis* is not confined to Indian seas. A number of species have been described by Garman from the Pacific Ocean. These, however, must represent a separate branch of the genus, for they do not possess the characteristic nasal spine. The species *Malthopsis mitrigar* (Gilbert and Cramer) from near the Hawaiian Isles possesses this spine. It would be most interesting to know how it resembles or differs from any of the five types described here as regards the arrangement of its ossicles.

Theoretical considerations.

It is fortunate that this case can be illustrated by photography so that it lies open to the consideration of all, for such wide and definite variation as these communities exhibit is rarely met with.

In regard to the change which may take place in organisms, it has been written "There are two factors: namely, the nature of the organism, and the nature of the conditions. The former seems to be much the more important; for nearly similar variations sometimes arise under, as far as we can judge, dissimilar conditions; and, on the other hand, dissimilar variations arise under conditions which appear to be nearly uniform" (*Origin of Species*, page 6, 6th Ed.). There are two reasons given here for the statement that the nature of the organism is much the more important factor in producing change. The present case forcibly illustrates both reasons. At any one of the four localities where, presumably, the conditions are uniform, different varieties seem to have arisen, and at any two localities where, presumably, the conditions might differ, similar varieties have arisen.

Therefore, as regards *Malthopsis* it may be said that the nature of the organism is much the more important if not the only factor in the change that is occurring.

If these five types are separate species in the ordinary sense of the word, they must, according to some theorists, have primarily arisen each in a separate locality, in adaptation to some peculiarity of that locality by natural selection from among a population exhibiting minute variations, and subsequently come together to exhibit the remarkable intermingled distribution obtained. This seems highly improbable.

It seems more likely that the type v, the true *Malthopsis lutea*, is an established species, which during a long period of stability has become widely distributed in moderate depths of the seas around India. One specimen of this type was taken by the "Valdivia" off the east coast of Africa. It is especially common at certain points in the Andaman Sea. Among the offspring which the members of the species are producing are some which differ widely from their parents as regards their shape and dermal ossicles, the differences being of particular kinds. Offspring showing the same kind of differences from their parents are being produced in widely separate localities. Judging from the fact that the type w occurs in each of the four communities, it may be assumed that it is a hardy and progressive form which is fast becoming established as a new species.

This is put forward as an explanation of the manner in which change is supposed to be taking place. As to the cause of the change nothing can be said from the evidence, except that it seems to be inherent in the organism and quite independent of the conditions of environment.

In many ways the phenomenon calls to mind that observed by De Vries in the plant *Œnothera*, a phenomenon which that author terms "Mutation." This term defines the manner in which evolution is believed to occur; by using it one allows exceptions to the rule that a parent and its offspring must be of the same species. So far as I can understand it, the Theory of Mutation does not deal with the causes which lead to the appearance of these exceptions, but emphasises the fact that the nature of the organism is a much more important factor in their production than the external conditions.

An important part of the Theory of Mutations is the idea of characters as definite units; an idea which seems to rest on the surest evidence. These fish illustrate this and moreover show how some of the character units are related to one another.

It has been shown that there are two types of subopercular spine among the collection, and that a particular type of spine is always associated with a particular arrangement of the dermal plate; that there are certain types in the form of the disk which are quite independent of the character of the derma, for one specimen (A 4) has preserved the narrow form but acquired the orderly character of the derma completely, while others (C 2, C 4) have lost the narrowness but retained the disorderly derma. It has also been shown that the nasal spine is quite independent of the subopercular spine, for all the specimens, whatever the form of their subopercular spines, possess nasal spines approximately of the same size and form. This is the opposite of what we might expect, for the nasal spine is a character peculiar to one branch of the genus *Malthopsis*, while the subopercular spine in various forms is

characteristic of other pediculate fish such as *Halicmetus*, *Dibranchus* and *Lophius*.[1] An essential character may therefore be more liable to change than a trivial one.

It sometimes happens that two animal forms resemble one another very closely as regards their specific characters though differing in some weightier generic character. Such a phenomenon is well known and is usually ascribed to "convergence," —a term of uncertain value.

It does not, however, necessarily follow that because two forms differ in a fundamental character, while resembling one another in certain specific characters, that these latter have been acquired independently in the two cases; nor does it follow that the two forms must have been long separated in their descent.

The case of *Platytroctegen* and *Platytroctes*, the case of *Chaunax pictus* and *C. apus* (*antea*) provide excellent illustrations of this principle.

[1] I assume that the "humeral" spine of *Lophius* is the same structure under another name, for it is based on the opercular bones, and has the same multifid form.

ILLUSTRATIONS

OF THE

ZOOLOGY

OF THE

ROYAL INDIAN MARINE SURVEY SHIP

INVESTIGATOR

UNDER THE COMMAND OF

COMMANDER W. G. BEAUCHAMP, R.I.M.

FISHES—Pt. X, Pls. XLIV—L.

UNDER THE DIRECTION OF

THE SUPERINTENDENT, INDIAN MUSEUM,

AND OF

THE SURGEON NATURALIST, INDIAN MARINE SURVEY.

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CALCUTTA
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1909

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N. ANNANDALE,

June, 23rd, 1909.

Superintendent, Indian Museum,
Nat. Hist. Section.

EXPLANATION OF PLATE XLIV.

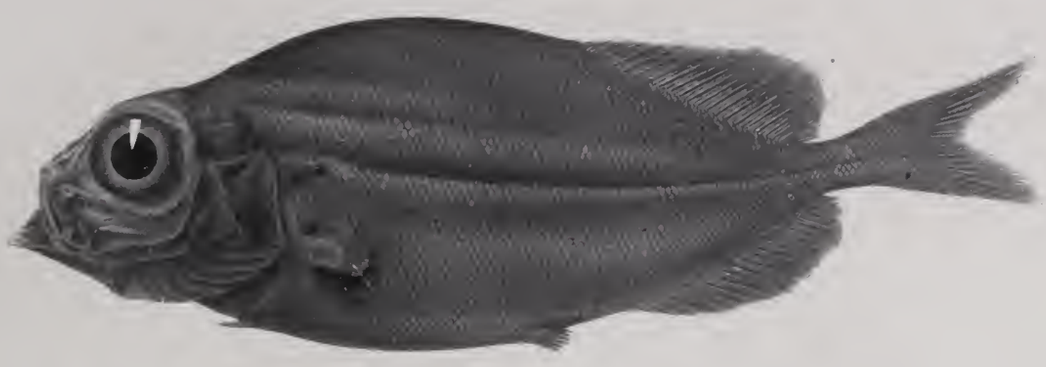
FIGS. 1, 1*a*. *Platytroctegen minus*, sp nov.

FIG. 2 *Alepocephalus longiceps*, sp. nov

„ 3. „ *macrops*, sp. nov.

„ 4. „ *microlepis*, sp. nov.

„ 5. *Kali indica*, sp. nov.



1.

1a.

2.

3.

4.

5.

Half-tone.

S. C. Mondul, *del.*

Survey of India Offices, Calcutta, 1939.

EXPLANATION OF PLATE XLV.

FIGS. 1, 1*a*. *Malthopsis triangularis*, sp. nov.

FIG. 2. *Dibranchus nudiventer*, sp. nov.

„ 3 *Liparoides beauchampi*, sp. nov.

„ 4. *Melanocætus*, sp.

FIGS. 5, 5*a*. *Lophius triradiatus*, sp. nov.

FIG. 6. *Chaunax apus*, sp. nov.

„ 7. *Lophodolus indicus*, sp nov.

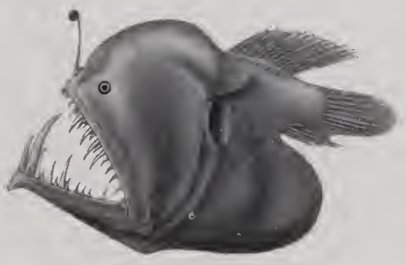
„ 8. *Notacanthus indicus*, sp. nov.

1.×1½.

2.

1a.×1½

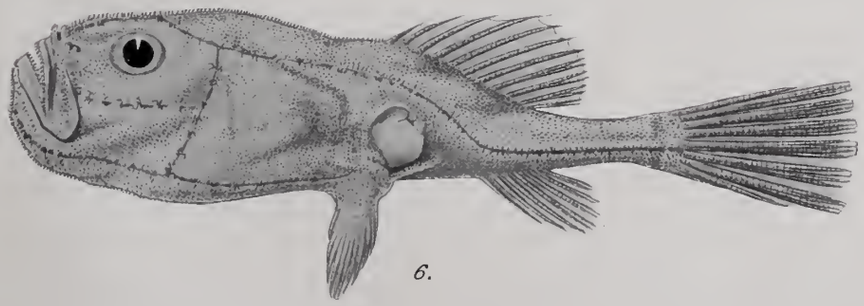
3.



4×2.

5.

5a.



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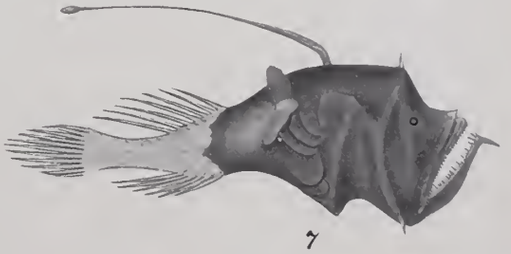

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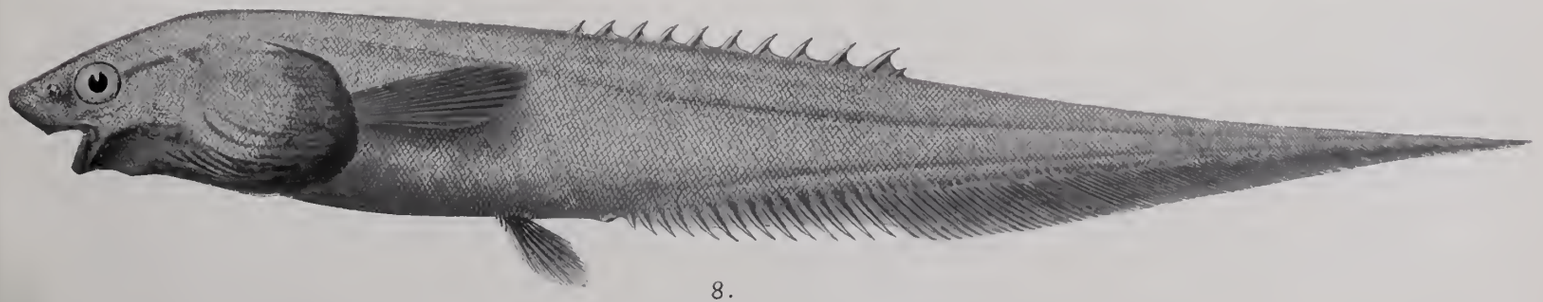

8.

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S. C. Mondul, *del.*

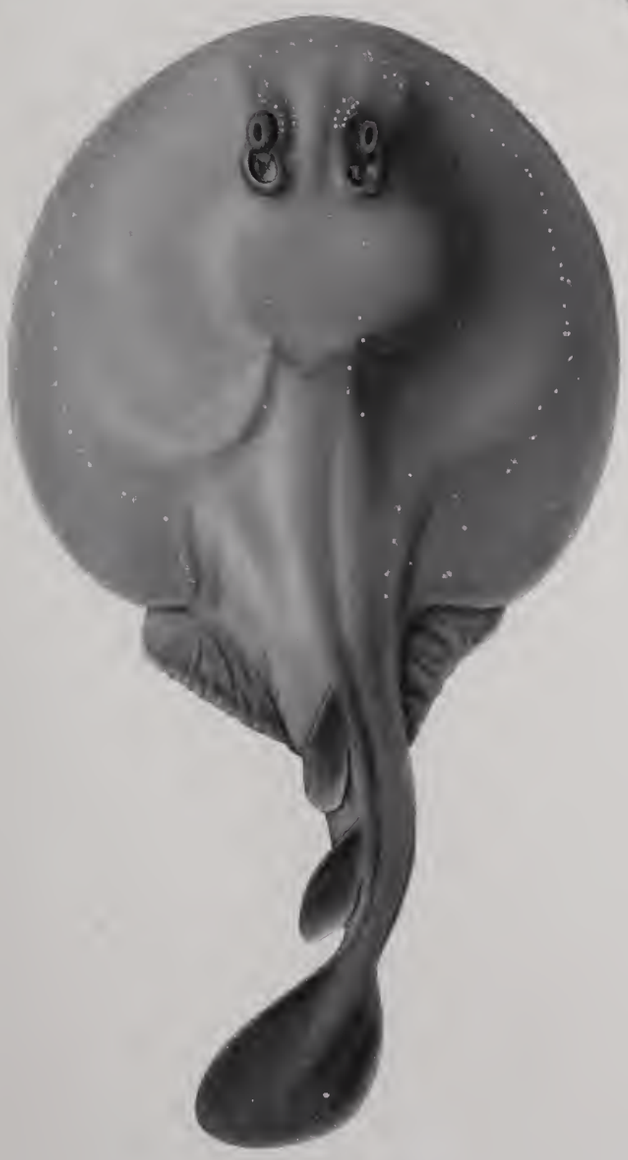
Survey of India Offices Calcutta 19..

EXPLANATION OF PLATE XLVI.

FIGS. 1, 1*a*. *Narcine mollis*, Lloyd

FIG. 2. *Raia andamanica*, sp nov.

1a. ×1½



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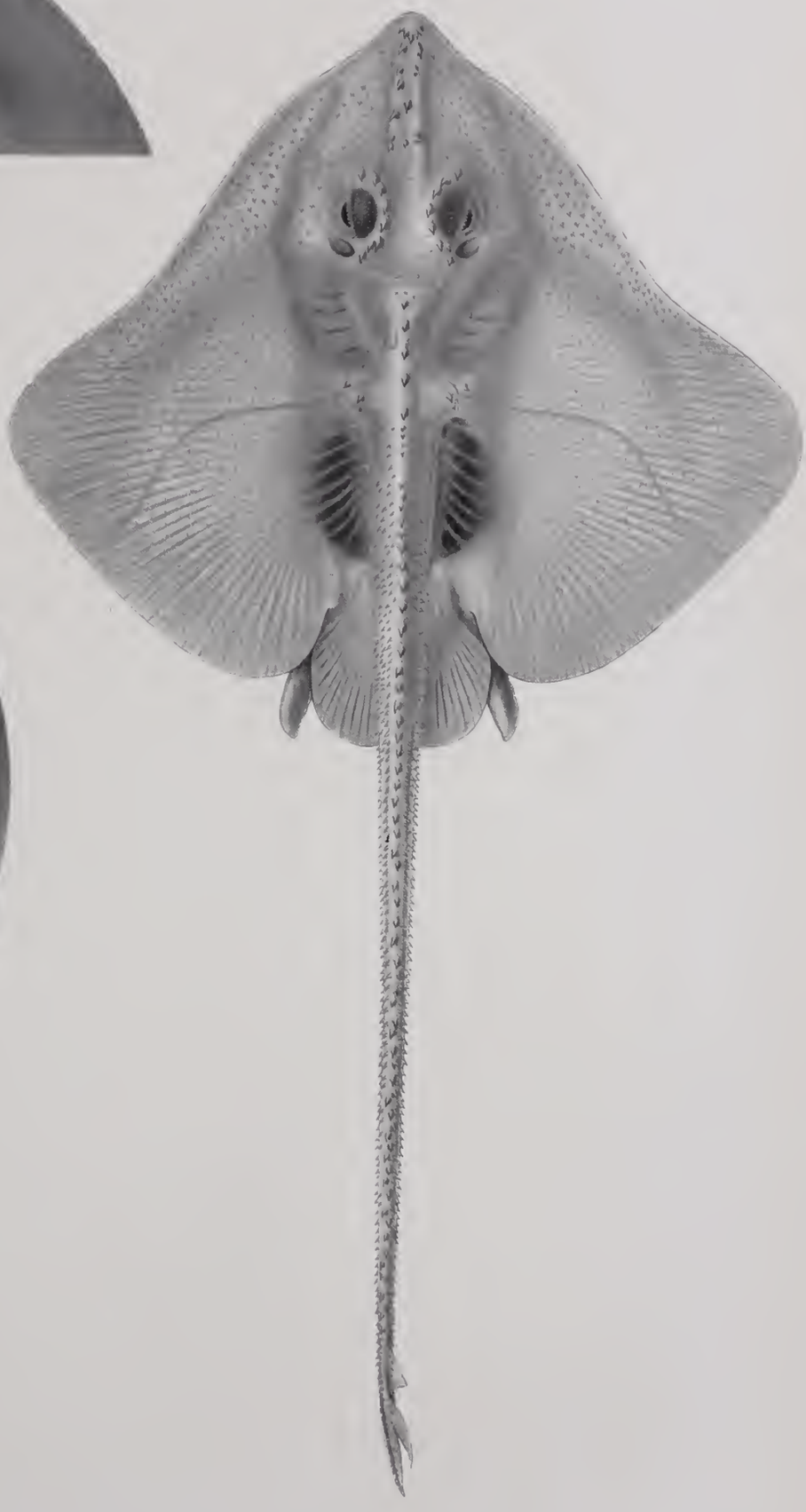


2.

Half-tone.

S. C. Mondul, *del.*

Survey of India Offices, Calcutta 1909.

EXPLANATION OF PLATE XLVII.

FIG. 1. *Synophobranchus pinnatus*, Günther, var. *brevidorsalis*, nov.

„ 2. *Gymnapistus affinis*, sp. nov.

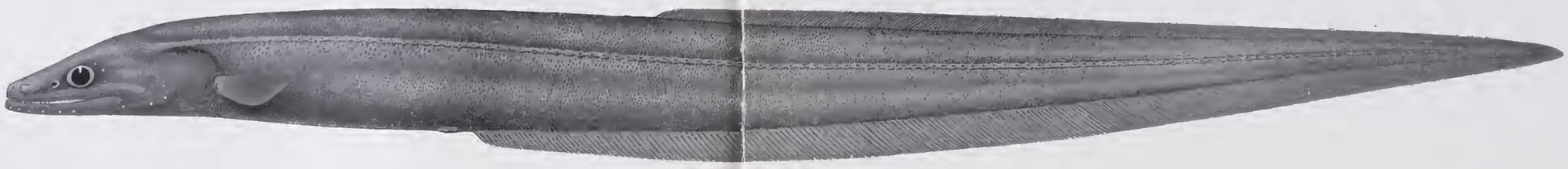
„ 3. *Minous longipinnis*, sp. nov.

„ 4. *Mulichthys squamiceps*, sp. nov.

„ 5. *Synagrops splendens*, sp. nov.

„ 6. *Psenes nigrescens*, sp. nov.

FIGS. 7, 7*a*. *Samaris inornata*, sp. nov.



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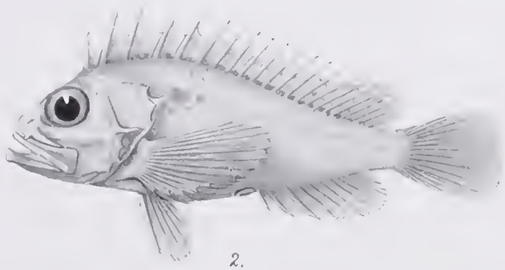

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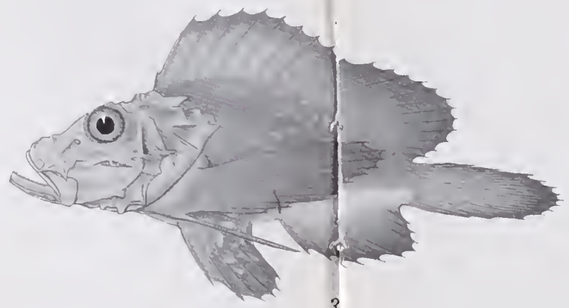


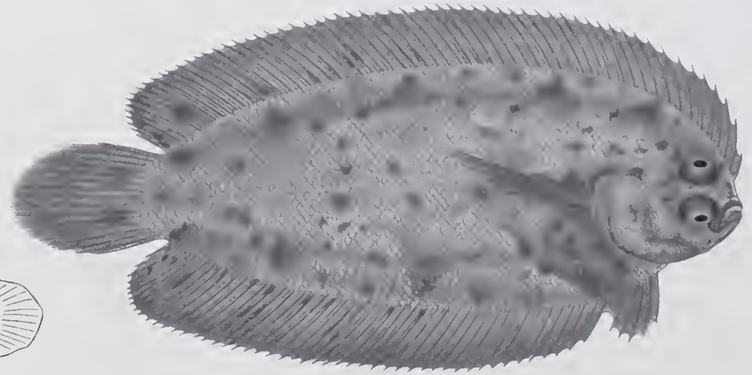
3.

4.

5.

6. ×2½.

7a. ×10.



7.

Tait-tes

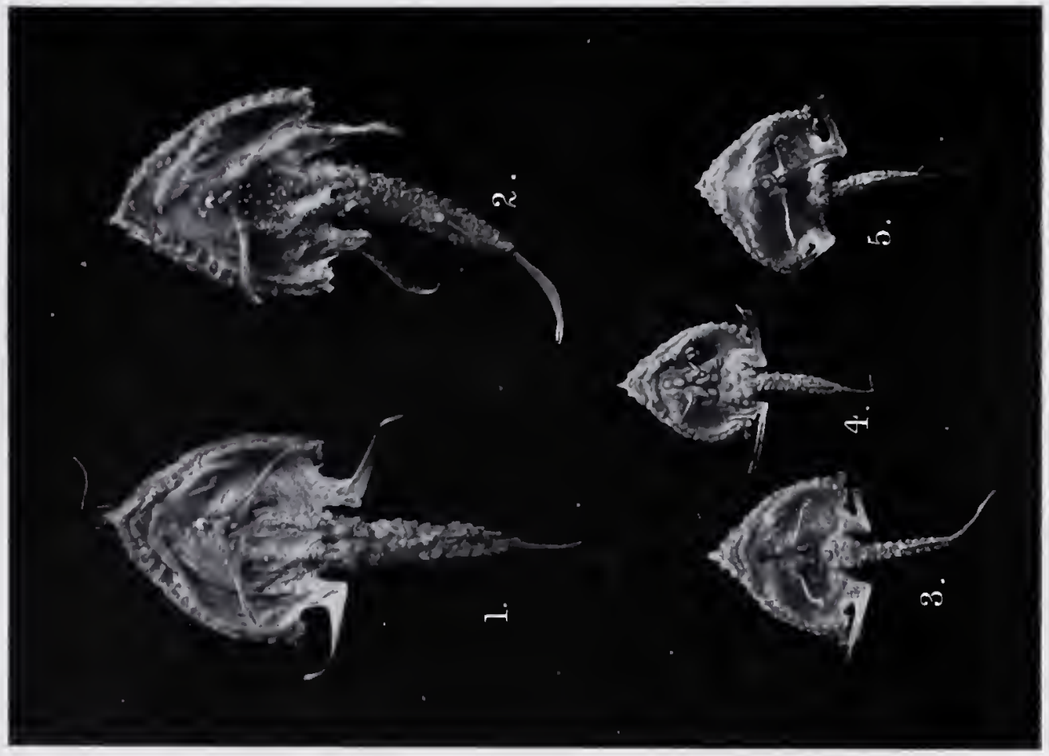
S. C. Mondul, *del.*

EXPLANATION OF PLATE XLVIII.

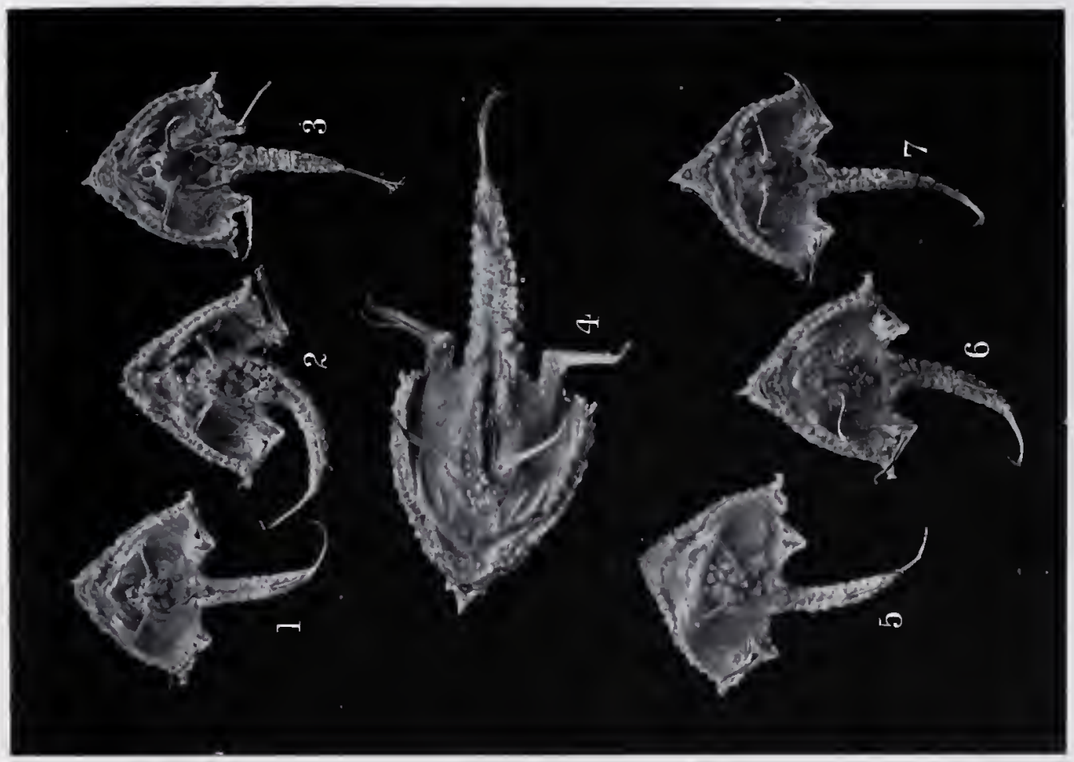
Figures of dorsal and ventral surface of specimens of *Malthopsis* of communities A and B:—

Group A, figs. 1, 2=type v; figs. 3, 5=type w; fig. 4=type x.

,, B, fig. 4=type v; figs. 1-3, 5-7=type w.



A



B

Half-tone.

Survey of India Offices, Calcutta, 1900.

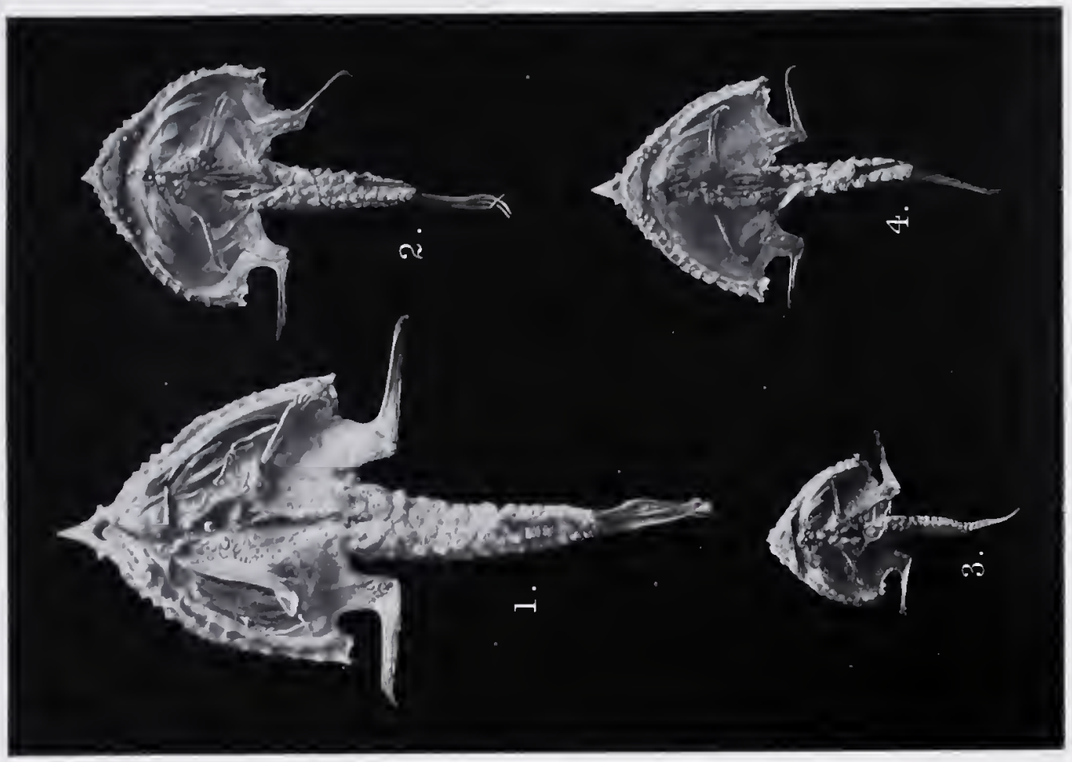
EXPLANATION OF PLATE XLIX.

Figures of dorsal and ventral surface of specimens of *Malthopsis* of communities C and D:—

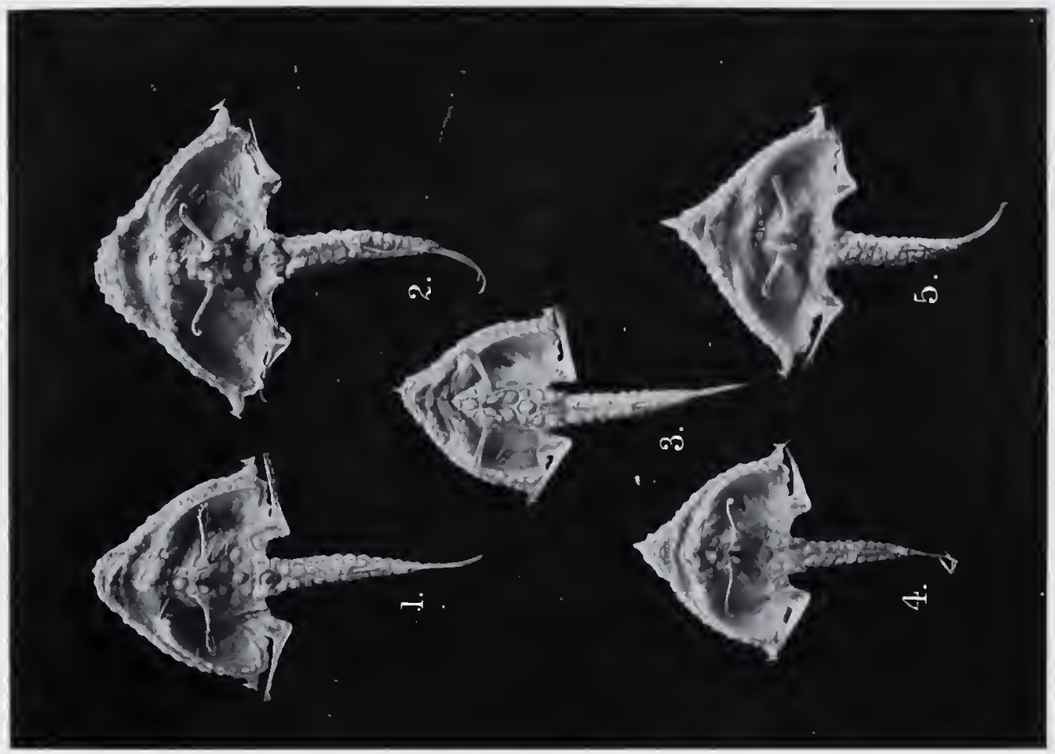
Group C, fig. 1 = type v; fig. 3 = type w; figs. 2, 4 = type y.

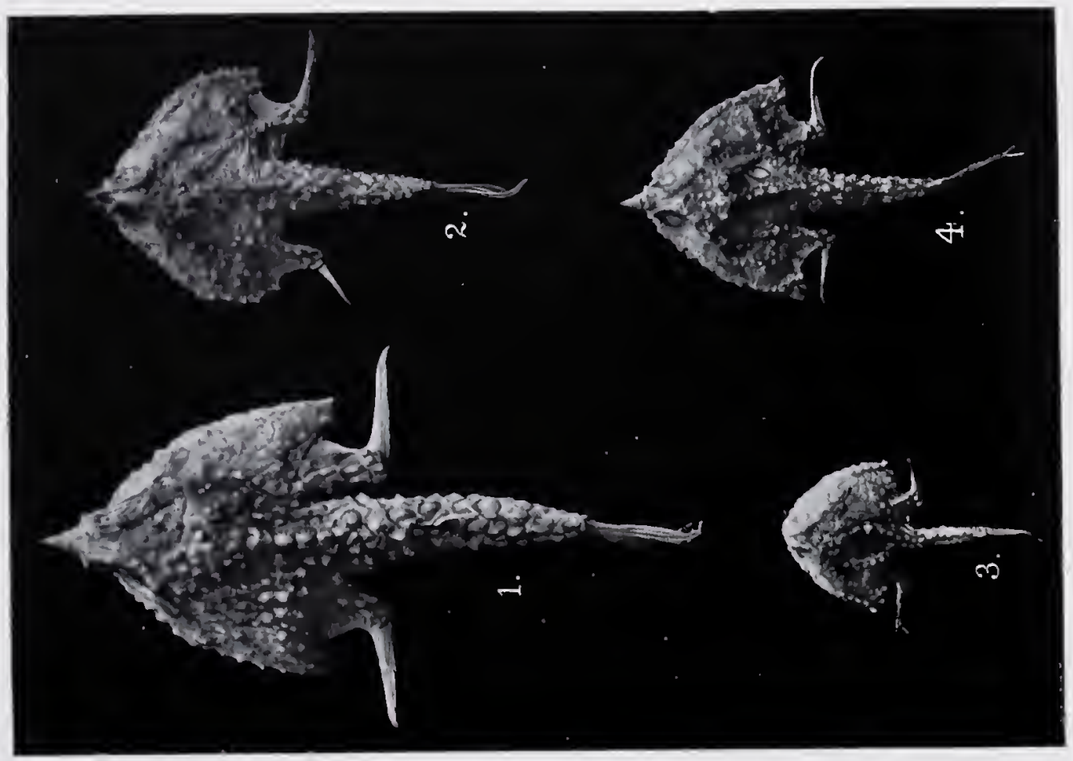
„ D, figs. 1, 3, 4 = type w; figs. 2, 5 = type z.

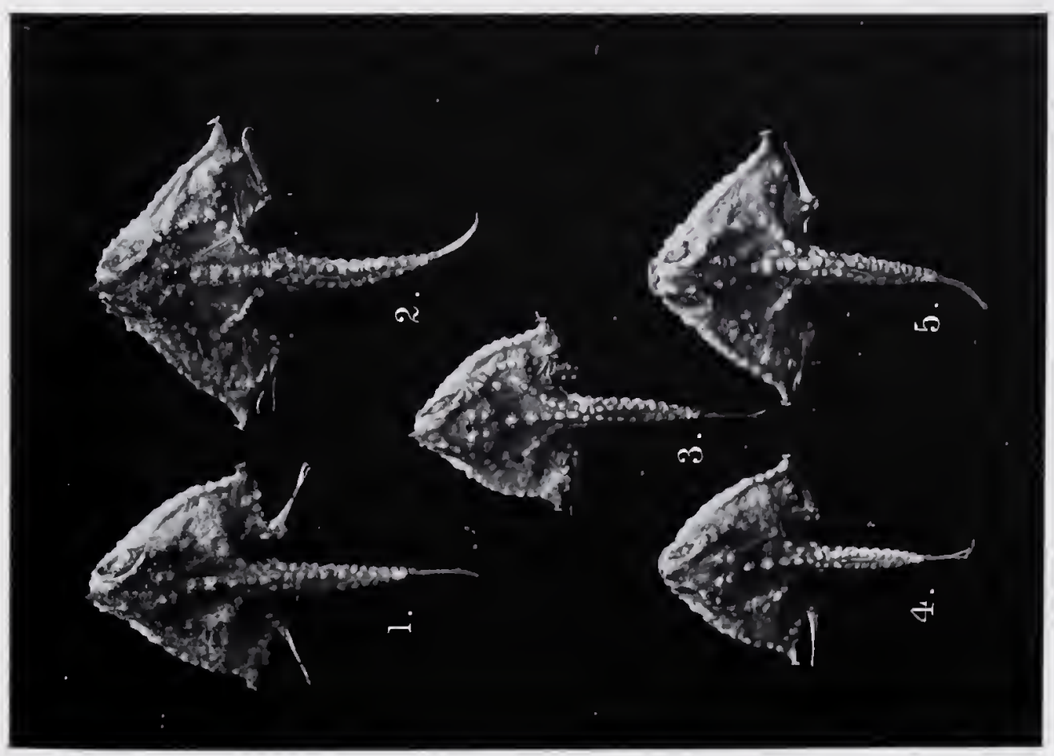
C



D





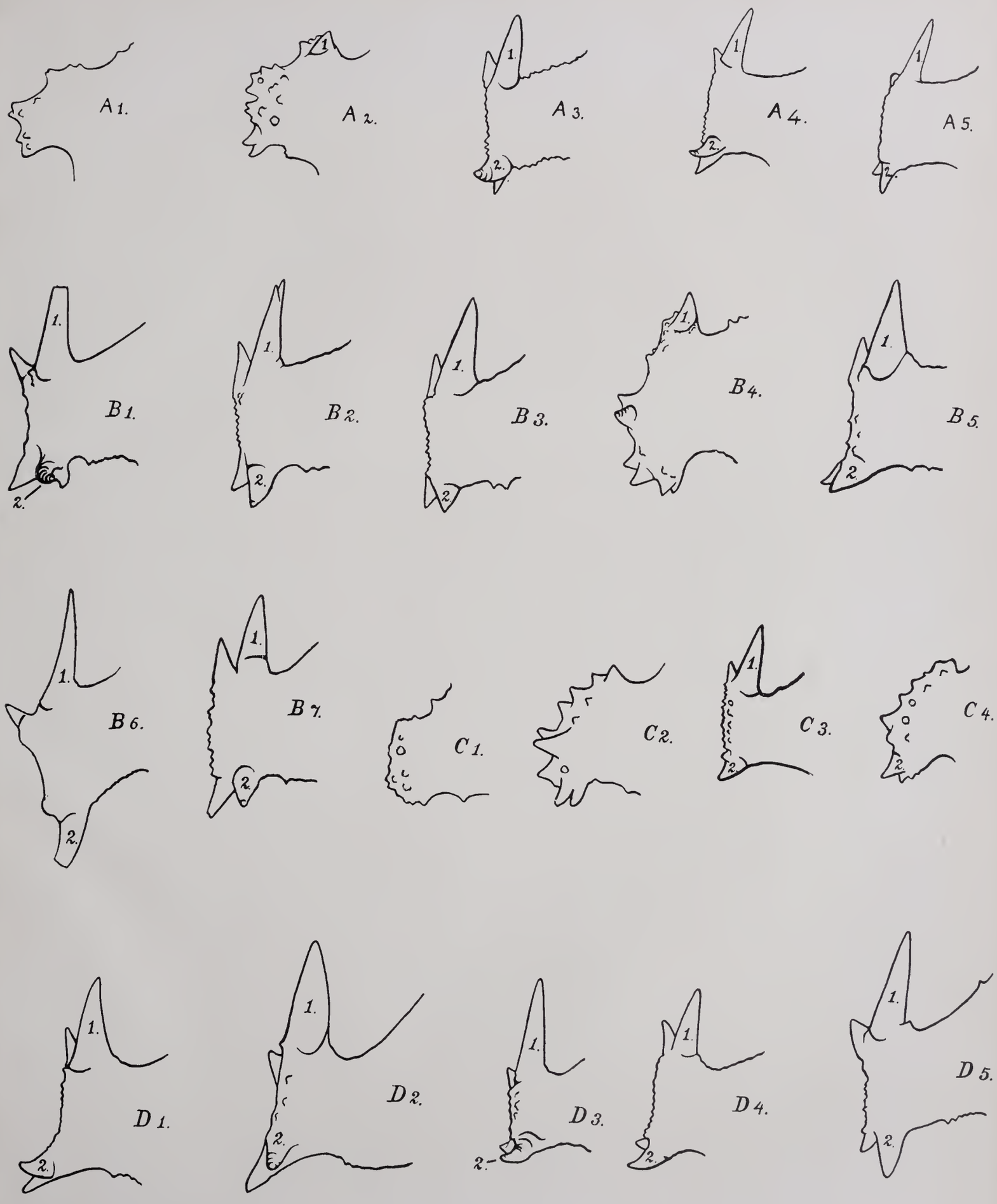


Half-tone.

urvey of India Offices Calcutta 1909.

EXPLANATION OF PLATE L.

Right postero-lateral spine of each of the specimens of *Malthopsis* shown on plates xlviii and xlix, × 25: 1 = antro-superior spinelet; 2 = postero-superior spinelet. Drawn with the camera lucida.



Scale 1 Millimetre.

Line-Block. Survey of India Offices, Calcutta, 1909.

ETUDE SUR LES CHIRONOMIDES DES INDES ORIENTALES, AVEC DESCRIPTION DE QUELQUES NOUVELLES ESPECES D'EGYPTE.

Par J. J. KIEFFER, *Doct. Phil. Nat., Prof. à Bitsch.*

Les Diptères de la famille des Chironomides semblent avoir été complètement négligés par les naturalistes qui ont collectionné en Asie.

Le Catalogue des "Chironomidæ" qui a paru en 1906 dans le "Genera Insectorum" de P. Wytsman, ne mentionne que 15 représentants de cette famille pour l'Asie ; sur ces 15 espèces, 7 reviennent à Java dont une,[1] *Chironomus cubiculorum*, Doll., aux Indes Orientales (?) et à Java, 3 aux Indes Orientales seules, à savoir *Chironomus socius*, Walk., *Chironomus vicarius*, Walk., et *Macropeza gibbosa*, Wied., 2 à Manilla, 1 à la Chine, 1 à Borneo et 1 à l'Asie Mineure. Depuis 1906 ce nombre s'est accru de 8 espèces pour Java. Quant aux Indes Orientales, il est demeuré stationnaire et on ne connait encore jusqu'à présent, pour cette région, que les quatre espèces mentionnées. Le zélé conservateur de l' Indian Museum de Calcutta, Monsieur N. Annandale, a donc bien mérité de la science, en collectionnant les Chironomides de ce pays et en leur assignant une place à la Section d'histoire naturelle de ce Museum. Cette collection, composée d'insectes recueillis dans les différentes parties des Indes, m'a été envoyée à déterminer par N. Annandale ; le résultat de mes observations fera l'objet de plusieurs travaux, dont le présent ouvre la série, en livrant à la publicité la description de 86 espèces nouvelles.

Je ferai remarquer qu'en comptant les articles antennaires, je ne nomme qu'un article basal, puisqu' il n'y a, en réalité, qu'un seul article basal apparent. J'appelle "*radius*" la partie distale de la 1e nervure longitudinale, qui commence à l'origine du cubitus ; "*sous-costale*" la partie proximale de la 1e nervure longitudinale; "*cellule radiale*," la cellule comprise entre le radius et le cubitus chez les Ceratopogonines, et qui est souvent double ; "*pointe alaire*," le point le plus distal de l'aile.

I. CERATOPOGONINÆ.

1er Genre, CERATOPOGON, Meigen.

Dernier article tarsal avec un empodium très distinct, métatarse souvent plus court que le 2e article ; ailes poilues sauf dans le sous-genre *Atrichopogon*.

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[1] La description de l'insecte de Calcutta, telle qu'elle a été publiée par Lionel de Nicéville (*Indian Museum Notes*, 1903, vol. v, p. 190), ne concorde pas avec la courte diagnose que Doleschall a donnée de *Chironomus cubiculorum* ; il est donc probable que les deux insectes diffèrent, spécifiquement, d'autant plus que celui de Calcutta a une taille presque 4 fois supérieur à celle de l'insecte de Java.

1.	Ailes poilues	2.
	Ailes non poilues mais avec des soies microscopiques	6. *C.* (*A.*) *indianus*, sp. nov.
2.	Ailes avec une tache blanche à l'extrémité du cubitus	3.
	Ailes avec une ou deux taches noires ..	4.
3.	Métatarse antérieur à peine plus court que le 2e article, 2-3 fois aussi long que gros ..	4. *C. albosignatus*, sp. nov.
	Métatarse antérieur beaucoup plus court que le 2e article, un peu plus long que gros ..	5. *C. albonotatus*, sp. nov.
4.	Aile avec une tache noire sur les cellules radiales ; métatarse antérieur égalant les deux tiers de la longueur du 2e article ..	3. *C. macrorhynchus*, sp. nov.
	Aile avec deux taches noires sur son bord antérieur ; métatarse antérieur n'atteignant pas la moitié du 2e article	5.
5.	Mesonotum mat, d'un brun marron, à poils longs et épars, partie distale de la discoïdale sessile	1. *C. decipiens*, sp. nov.
	Mesonotum d'un brun noir, avec une pubescence d'un jaune d'or ; partie distale de la discoïdale pétiolée	2. *C. auronitens*, sp. nov.

1. *Ceratopogon decipiens*, sp. nov.

(Pl. xi, fig. 10, aile.)

♂. D'un blanc jaunâtre ; antennes et panache brunâtres ; dessus du thorax d'un roux marron, balanciers et abdomen d'un blanc pur, sauf un anneau sur chaque segment et les trois derniers en entier, ainsi que la pince, qui sont noirs. Bouche assez longue, subcylindrique, 2e article des palpes grossi au milieu. Antennes de 14 articles ; panache étalé, comme chez les Chironomines, et non appliqué comme chez les autres Ceratopogonines ; les poils des verticilles partent d'une ligne oblique et crénelée ; articles 3-10 globuleux avec un col très court, munis d'un verticille ainsi que la base du 11e ; article 11e globuleux à sa base, avec un col cylindrique aussi long que les 5 articles précédents réunis ; articles 12-14 cylindriques et sans verticille de poils ; 12e et 13e deux à trois fois aussi longs que gros, le 14e un peu plus long que le 13e. Mesonotum fortement convexe, à poils roussâtres et assez longs mais peu denses. Ailes presque hyalines, légèrement enfumées, avec deux taches noires, qui sont situées l'une sur les cellules radiales, l'autre à l'extrémité du rameau supérieur de la nervure intercalée ; surface couverte de poils longs et appliqués ; cubitus n'atteignant pas le milieu de l'aile ; 1e cellule radiale aussi longue mais plus étroite que la 2e ; transversale oblique ; discoïdale bifurquée sous la transversale ; rameau supérieur droit, continuant la direction de la partie basale et aboutissant à peine au-dessus de la pointe alaire ; bifurcation de la posticale située sous l'extrémité du

cubitus ; nervure anale simple. Pattes grêles comme les Chironomines, longuement poilues ; le tibia postérieur a en dehors, 4-5 poils dressés et six fois aussi longs que son épaisseur ; entre les longs poils des pattes se trouvent encore des poils écailleux et appliqués ; tibia antérieur sans peigne ; métatarse antérieur atteignant seulement le quart du 2e article ; le 5e article encore 2-3 fois aussi long que gros, plus court que le 4e ; crochets tarsaux grêles, courbés à angle droit, à peine plus longs que l'empodium, qui est assez large. Abdomen grêle, cylindrique, deux fois aussi long que le reste du corps, avec des poils assez denses, blanchâtres et plus longs que la grosseur des segments ; les segments 2-5 ont en avant un anneau noir qui, sur la partie ventrale, se prolonge en arrière en formant une bande médiane, longitudinale et presque percurrente. Taille 3·5 mm.

Simla, à une altitude de 2,340 m., en mai (N. Annandale).

Cette espèce a l'aspect d'un Tanypine ou d'un Chironomine, sauf que le thorax n'est pas prolongé au-dessus de la tête.

2. *Ceratopogon auronitens*, sp. nov.

(Pl. xi, fig. 12, aile.)

♂. D'un brun noir et mat ; dessus du thorax avec une pubescence d'un jaune d'or ; pleures et sternum d'un brun roussâtre, balanciers et genoux jaunâtres. Bouche presque cylindrique et assez longue. Articles 3-10 des antennes globuleux, avec un col très court, le 11e globuleux à sa base, avec un col égalant la longueur des 4 ou 5 articles précédents réunis ; 12e et 13e cylindriques et deux fois aussi longs que gros ; 14e un peu plus gros mais pas plus long que le 13e ; articles 2-10, ainsi que la base du 11e, avec un verticille de longues soies divariquées, formant un panache. Ailes d'un blanc de lait, avec deux taches noires et presque carrées, dont l'une couvre les cellules radiales et l'autre est située à l'extrémité du rameau supérieur de la nervure intercalée ; surface avec des poils longs et appliqués ; cubitus n'atteignant pas le milieu de l'aile, soudé au radius dans sa moitié proximale ; transversale oblique, aboutissant au pétiole de la discoïdale ; bifurcation de la discoïdale située sous l'extrémité du cubitus, son rameau supérieur droit et aboutissant à la pointe alaire ; bifurcation de la posticale située un peu en arrière de celle de la discoïdale ; nervure anale simple. Pattes assez robustes, les fémurs plus gros que les tibias ; poils dressés du tibia quatre fois aussi longs que son épaisseur ; métatarse antérieur un peu plus court que la moitié du 2e article ; 5e article encore 2-3 fois aussi long que gros, un peu plus court que le 4e ; crochets arqués, pas plus longs que l'empodium Abdomen grêle, presque deux fois aussi long que le reste du corps, avec des poils noirâtres et longs, surtout au dernier segment et à la pince. Taille 2 mm.

Base des côtes de Dawna, Lower Burma (N. Annandale).

3. *Ceratopogon macrorhynchus*, sp. nov.

(Pl. ix, fig. 3, bouche et palpes ; fig. 8, six derniers articles antennaires.)

♂. Brun ; bouche, palpes, antennes, pleures, hanches et pattes d'un jaune brunâtre. Yeux glabres, très distants au vertex. Palpes longs, composés de 4

articles, dont les deux derniers sont minces et petits, le 2e le plus long, aminci dans sa moitié apicale (pl. ix, fig. 3). Bouche longue, en forme de trompe cylindrique, extrémité bilobée et un peu élargie (pl. ix, fig. 3). Antennes de 14 articles; les articles 2-5 globuleux; 6-10 graduellement allongés et amincis vers le haut; 11e composé d'une nodosité basale terminée par un col cylindrique et quatre fois aussi long que la nodosité; 12e et 13e conformés de la même façon que le 11e, mais à col graduellement plus court, trois fois et deux fois plus long que la nodosité; 14e article de la longueur du 13e, mais plus gros, subcylindrique, aminci au bout (pl. ix, fig. 8); la partie basale des articles porte une ligne oblique et crénelée, de laquelle partent les poils du panache, dont la longueur atteint celle des articles 2-9 réunis. Ailes couvertes de poils élargis au milieu, avec une tache noire, allongée et étroite, qui couvre les cellules radiales et qui est produite par des écailles noires plus larges et plus denses que les poils; cubitus aboutissant après le tiers basal de l'aile, parallèle au radius auquel il est relié en son milieu; rameau supérieur de la discoïdale aboutissant à l'extrémité alaire, le rameau inférieur visible seulement dans sa partie apicale; rameau supérieur de la posticale continuant la direction de la tige, presque droit; l'inférieur très oblique; bifurcation de la posticale située en arrière de l'extrémité du cubitus. Pattes couvertes d'écailles qui sont noires, linéaires, et brièvement velues; tibias sans peigne; aux pattes antérieures le métatarse est égal aux deux tiers du 2e article, tous deux avec des spinules alignées sur le dessous; 2e article égal aux 3e et 4e réunis; 5e de moitié plus long que gros; aux pattes postérieures la proportion est la même; empodium large, aussi long que les crochets. Articles basaux de la pince subcylindriques; articles terminaux arqués, grêles, graduellement amincis de la base au sommet. Taille 1·5 mm.

Calcutta, juillet, 1907 (N. Annandale).

4. *Ceratopogon albosignatus*, sp. nov.

♂. Face et bouche blanchâtres; antennes et panache d'un brun noir; thorax brun; balanciers d'un blanc de lait; pattes et hanches d'un jaune clair, tarses plus sombres, aux pattes postérieures la moitié distale des fémurs et la moitié proximale des tibias sont d'un brun noir; abdomen d'un brun noir, avec des anneaux jaunes plus minces sur les derniers segments. Yeux confluents au vertex. Articles 3-10 du flagellum un peu transversaux, 11-14 cylindriques et un peu plus longs que gros; panache dense, appliqué, atteignant l'extrémité des antennes. Mesonotum avec une pubescence jaune et peu dense; scutellum avec quelques longs poils dressés. Ailes densément couvertes de poils sombres et appliqués, avec une tache blanche, presque carrée, située à l'extrémité du cubitus; rameau supérieur de la nervure intercalée bordé de brun; cubitus atteignant le milieu de l'aile, soudé au radius dans sa moitié basale; l'extrémité du rameau supérieur de la nervure intercalée est un peu plus distant de la pointe alaire que le rameau supérieur de la posticale, son rameau inférieur est très rapproché de la discoïdale, dont il atteint presque l'extrémité; discoïdale bifurquée sous la transversale; son rameau supérieur aboutissant un peu au-dessus de la pointe alaire, dont il est aussi distant que le rameau inférieur;

bifurcation de la posticale située sous l'extrémité du cubitus ; anale simple. Tous les tibias, plus faiblement aussi les fémurs et les métatarses, avec des poils dressés en dehors, 2-3 fois aussi longs que l'épaisseur des pattes ; métatarse antérieur à peine plus court que le 2e article, 2-3 fois aussi long que gros, 4e article un peu plus long que gros. Abdomen grêle, subcylindrique, de moitié plus long que le reste du corps, avec des poils longs, dressés et noirâtres. Taille 1-3 mm.

Rangoon, Burma, en février (N. Annandale).

5. *Ceratopogon albonotatus*, sp. nov.

(Pl. viii, fig. 10, aile.)

♂. Fauve ; dessus du thorax et de l'abdomen plus sombre ; balanciers d'un blanc de lait. Yeux confluents. Articles du flagellum subglobuleux, à verticilles deux fois aussi longs que gros, les 5 derniers cylindriques, un peu plus longs que gros. Thorax à poils jaunes et assez longs, surtout sur le dessus, très longs sur le scutellum. Ailes enfumées (pl. viii, fig. 10) à poils noirs, très denses sur la cellule costale et en arrière de la cellule radiale, par suite les deux tiers proximaux de l'aile offrent une bande noire le long du bord antérieur, à l'extrémité du cubitus se trouve une tache d'un blanc de lait, où les poils et les nervures sont blancs ; cubitus aboutissant au bord un peu après le milieu ; 1e cellule radiale très étroite, aussi longue que la distale qui est à peine plus large ; bifurcation de la discoïdale située sous la transversale, rameau supérieur aboutissant à la pointe alaire ; bifurcation de la posticale située vis-à-vis de l'extrémité du cubitus ; sans nervure anale bifurquée. Tibias et tarses longuement velus en dehors, poils 2-3 fois aussi longs que la grosseur des pattes ; métatarse des pattes antérieures et postérieures un peu plus long que gros, 2e article deux fois aussi long que gros. Abdomen déprimé, large, aussi long que le reste du corps. Taille 1·5 mm.

Calcutta, 3 mai (N. Annandale).

6. *Ceratopogon* (*Atrichopogon*) *indianus*, sp. nov.

(Pl. viii, fig. 12, aile.)

♂. D'un roux jaunâtre et brillant ; dessus du thorax d'un brun noir ; balanciers d'un blanc de lait ; antennes roussâtres, panache d'un gris blanchâtre. Bouche longue, subcylindrique ; palpes très courts, probablement de 2 ou 3 articles. Articles du flagellum subglobuleux, les derniers allongés ; panache dense, atteignant presque l'extrémité des antennes. Ailes hyalines (pl. viii, fig. 12), non poilues mais à soies microscopiques et denses, bord inférieur cilié ; radius atteignant le milieu de l'aile ; cubitus soudé au radius dans sa moitié proximale, à son extrémité il est distant du radius de la moitié de sa longueur ; discoïdale bifurquée sous la transversale, rameau supérieur droit ; bifurcation de la posticale située un peu au delà de la transversale ; anale simple. Pattes sans longs poils ; tibias postérieurs avec un peigne double, métatarse de toutes les pattes égal aux 4 articles suivants réunis, 4e article un peu plus long que gros, plus court que le 5e ; empodium étroit, un peu plus court que les

crochets, longuement poilu sur le dessous. Abdomen mince, plus long que le reste du corps, subcylindrique. Taille 1 mm.

Calcutta, Jardin Zoologique, en août (N. Annandale).

2e Genre, Culicoides, Latr.

1. Ailes hyalines, sans taches, velues sur toute leur surface; cubitus confluent avec le radius sauf parfois l'extrémité; discoïdale sessile .. .. .. 2.
   Ailes avec des taches, velues seulement au bout; cubitus non confluent avec le radius; discoïdale pétiolée; bouche longue et pointue .. .. 10.
2. Cubitus soudé au radius sur toute son étendue 3.
   Cubitus soudé au radius à sa base, séparé de lui à son extrémité; corps roux .. 12. *C. paivai*, sp. nov.
3. Cubitus atteignant ou dépassant le milieu de l'aile .. .. 4.
   Cubitus n'atteignant pas le milieu de l'aile 3. *C. montivagus*, sp. nov.
4. Métatarse antérieur pas plus long que les articles 2 et 3 réunis; bouche de la femelle petite et obtuse .. .. .. 1. *C. brevimanus*, sp. nov.
   Métatarse aussi long que les 4 articles suivants réunis .. .. .. 5.
5. Corps noir .. .. .. 6.
   Corps orangé ou blanchâtre, dessus du thorax ou du corps brun .. .. 9.
6. Mesonotum très brillant; bouche petite .. 6. *C. nitidulus*, sp. nov.
   Mesonotum mat .. .. .. 7.
7. Dessus du thorax pruineux de gris; articles antennaires 11-13 en ovoïde allongé; bouche petite .. .. .. 5. *C. scapularis*, sp. nov.
   Dessus du thorax non pruineux .. .. 8.
8. Articles antennaires 3-9 en ovoïde court, 10-14 deux fois aussi longs que gros; bouche longue .. .. .. 2. *C. macrostoma*, sp. nov.
   Articles antennaires 3-10 globuleux, les suivants trois fois aussi longs que gros; bouche petite .. .. .. 4. *C. opacus*, sp. nov.
9. Bouche de la femelle longue et pointue; lamelle supérieure de la pince du mâle tronquée et portant à chaque angle postérieur deux petits lobes .. .. 7. *C. quadrilobatus*, sp. nov.

Bouche de la femelle petite et obtuse ; lamelle supérieure de la pince du mâle avec un faisceau de soies à chaque angle postérieur .. .. 8. *C. setiger*, sp. nov.

10. Ailes enfumées, avec des taches hyalines .. 11.
Ailes hyalines ou blanches avec des taches enfumées et irrisées .. .. 12.

11. Surface alaire densément couverte de soies microscopiques .. .. .. 9. *C. peregrinus*, sp. nov.
Taches hyalines des ailes complètement dépourvues de soies et de ponctuation .. 13. *C. oxystoma*, sp. nov.

12. Surface alaire avec une ponctuation également dense, formée par des soies microscopiques ; cubitus divergent du radius dans sa moitié distale .. .. 10. *C. molestus*, sp. nov.
Surface alaire presque nue, à ponctuation à peine perceptible ; taches enfumées avec des soies microscopiques ; cubitus très rapproché du radius sur toute sa longueur 11. *C. odiosus*, sp. nov.

1. *Culicoides brevimanus*, sp. nov.

♀. Thorax jaunâtre, à dessus d'un noir brillant ; dessus de l'abdomen avec de larges bandes transversales brunes, qui occupent presque toute la partie dorsale ; dessous de l'abdomen blanchâtre ; antennes et pattes brunâtres ; balanciers blancs. Yeux pubescents. Bouche petite, obtuse. Palpes de quatre articles courts. Antennes de 14 articles, dont les cinq derniers sont subcylindriques, $2\frac{1}{2}$ fois aussi longs que gros, le dernier guère plus long que l'avant-dernier ; articles 2-4 subglobuleux, 5-9 presque deux fois aussi longs que gros et subcylindriques ; poils deux fois aussi longs que les articles ; appendices subuliformes un peu plus courts que les articles. Ailes hyalines et velues ; cubitus dépassant un peu le milieu de l'aile, confondu sur tout son parcours avec le radius ; transversale oblique ; rameau supérieur de la discoïdale continuant la direction de la base, aboutissant à la pointe alaire, bifurcation située sous la transversale ; entre le cubitus et la discoïdale se voit une fausse nervure bifurquée ; rameau supérieur de la posticale droit, continuant la direction de la tige ; rameau inférieur oblique et court. Tibias antérieurs avec deux larges éperons ; tibias postérieurs avec un peigne à spinules libres depuis leur base ; tarses à soies assez denses sur le dessous, à longs poils sur le dessus ; métatarse antérieur aussi long que les articles 2 et 3 réunis ; métatarse postérieur aussi long que les quatre articles suivants réunis ; empodium nul. Abdomen gros, un peu plus long que la tête et le thorax réunis ; lamelles subcirculaires. Taille 1·2 mm.

Calcutta, juillet, 1907 (N. Annandale).

2. *Culicoides macrostoma*, sp. nov.

(Pl. viii, fig. 4, aile ; pl. xi, fig. 14, parties buccales.)

♀ ♂. Noir, mat et glabre ; face, bouche, palpes et antennes d'un brun clair ; balanciers, hanches et pattes d'un blanc brunâtre. Yeux pubescents, sinueux, confluents au vertex. Bouche (pl. xi, fig. 14) longue, avec un suçoir pointu, entouré de deux lobes larges ; palpes à 4 articles courts et cylindriques. Articles antennaires 3-9 en ovoïde court, 10-14 deux fois aussi longs que gros. Ailes hyalines (pl. viii, fig. 4), non ponctuées, avec des poils alignés longitudinalement entre les nervures et sur les nervures, disposés sans ordre le long des bords ; cubitus confluent avec le radius et ne formant qu'une grosse nervure avec lui, dépassant le milieu de l'aile ; transversale très oblique ; discoïdale bifurquée sous la transversale ; bifurcation de la posticale située à peine avant l'extrémité du cubitus ; anale simple. Dessus des tibias et des tarses avec quelques poils longs et épars ; dessous des tarses postérieurs à soies denses et courtes, 4e article tarsal deux fois aussi long que gros, un peu plus court que le 5e ; tibias antérieurs et postérieurs avec un peigne, les intermédiaires sans peigne ; tibias postérieurs d'un tiers plus longs que le métatarse, celui-ci égal aux 3 articles suivants réunis ; empodium nul. Taille 1 mm.

Calcutta, en février (N. Annandale).

3. *Culicoides montivagus*, sp. nov.

(Pl. viii, fig. 3, aile.)

♂. Noir, mat et glabre ; balanciers d'un blanc de lait ; scutellum d'un roux marron ; hanches et pattes blanchâtres. Panache dense, d'un brun noir, atteignant l'extrémité des antennes ; articles 3-9 subglobuleux, 10-14 trois fois aussi longs que gros. Ailes hyalines (pl. viii, fig. 3), sans ponctuation, poilues ; la nervation ne diffère de celle du précédent que par le cubitus qui n'atteint pas le milieu alaire et qui est distant du bord sauf à son extrémité, et par la bifurcation de la posticale qui est située au-delà de l'extrémité du cubitus. Tibias intermédiaires et postérieurs, et les 4 premiers articles des tarses postérieurs avec des poils 5-6 fois aussi longs que l'épaisseur des articles ; tibias postérieurs avec un peigne double, les intermédiaires sans peigne ; dessous des 4 premiers articles des tarses postérieurs à soies denses et aussi longues que l'épaisseur des articles ; métatarse égal aux 3 articles suivants réunis ; 4e article encore trois fois aussi long que gros, un peu plus court que le 5e ; crochets avec des soies à leur base. Taille 1 mm.

Simla, à une altitude de 2,400 m., en mai (N. Annandale).

4. *Culicoides opacus*, sp. nov.

(Pl. xi, fig. 3, antenne de la femelle.)

♀ ♂. Noir, mat et glabre ; face et palpes d'un brun clair ; antennes et pattes d'un jaune brunâtre ; balanciers blanchâtres ; scutellum roux. Bouche petite.

Antennes (pl. xi, fig. 3) à articles 2-10 globuleux ; à poils pas plus longs que leur épaisseur, les 4 derniers cylindriques, deux fois aussi longs que le 10e, le dernier des quatre grossi. Ailes hyalines et velues ; radius aboutissant au milieu ; cubitus soudé au radius sur toute sa longueur, tous deux, à partir de l'origine du cubitus, à peine séparés du bord ; 2e partie du radius guère plus courte que la 1e ; transversale très oblique, formant le prolongement du cubitus ; bifurcation de la discoïdale située à la transversale, rameau supérieur aboutissant à la pointe alaire ; bifurcation de la posticale située sous l'extrémité du radius, rameau supérieur droit et continuant la direction de la tige. Pattes sans longs poils ; tibias antérieurs à peine plus courts que le tarse ; métatarse égal aux 4 articles suivants réunis, 4e article presque deux fois aussi long que gros, un peu plus court que le 5e ; crochets simples, avec quelques soies à leur base, sur le dessous ; sans empodium distinct.

Le ♂ diffère de la ♀ par les antennes d'un brun noir, mais conformées comme chez la femelle, sauf qu'elles ont un panache d'un brun noir ; les 4 pattes postérieures ont le fémur, le tibia et les deux premiers articles tarsaux munis de poils 2-3 fois aussi longs que leur épaisseur. Taille 1 mm.

Calcutta, 6—7-ii-08 (N. Annandale).

5. *Culicoides scapularis*, sp. nov.

♀ ♂. Noir, mat ; bord occipital blanchâtre ; antennes d'un noir brun ; thorax d'un brun noir, pruineux de gris, côtés et dessous d'un roux brun, scutellum d'un roux marron ; balanciers blanchâtres, épaules, hanches et pattes jaunes. Articles antennaires 11-13 de la femelle en ovoïde allongé, pas deux fois aussi longs que le 10e ; 2-10 et le 14e ainsi que les antennes du mâle conformés comme chez le précédent. Ailes du précédent. Tibias postérieurs avec un peigne, les intermédiaires sans peigne. Abdomen d'un noir mat, avec les incisions blanchâtres. Quant au reste, semblable au précédent. Taille 1 mm.

Calcutta, février (N. Annandale).

6. *Culicoides nitidulus*, sp. nov.

♀. Noir, mat ; dessus du thorax d'un noir très brillant ; scutellum et parfois les pleures et les épaules d'un roux marron ; antennes d'un brun noir ; pattes d'un jaune brunâtre ; balanciers blanchâtres. Antennes comme chez *scapularis*, 14e article pas plus gros que les précédents. Ailes et pattes comme chez *opacus*. Taille 1 mm.

Calcutta, février, juin et juillet (N. Annandale) ; base du Dawna Hills, en mars, L. Burma.

7. *Culicoides quadrilobatus*, sp. nov.

(Pl. ix, fig. 4, articles antennaires 9-12 du mâle ; fig. 2, pince ; pl. x, fig. 8, bouche de la femelle ; fig. 10, peigne du tibia.)

♀ ♂. Orangé ; dessus du corps, milieu de la poitrine, antennes et articulations des pattes bruns ; balanciers blancs. Yeux confluents, très finement et très brièvement velus. Bouche du mâle composée de lobes plus larges que longs et arrondis à

l'extrémité ; palpes courts, articles 1 et 3 guère plus longs que gros, 2e et 4e deux fois plus longs que le 3e. Bouche de la femelle apte à forer et à sucer (pl. x, fig. 8), composée de deux lobes obtus, allongés, glabres, entre lesquelles se voit une tige filiforme, un peu plus longue et pointue au bout ; le 2e article des palpes est le plus long et a sa plus grande largeur en dessous du milieu, le 1e et le 2e pas plus longs que gros ; le 4e à peine séparé du 3e et deux fois plus long. Antennes de 14 articles ; chez la femelle, les articles 2-5 sont subglobuleux ; 6-9 cylindriques et deux fois aussi longs que gros ; 10-13 deux fois et demie aussi longs que gros, et un peu amincis dans leur tiers apical ; 14e de moitié plus long que le 13e ; verticilles atteignant le milieu de l'article suivant. Chez le mâle, les antennes sont munies d'un plumet, dont les soies atteignent la longueur des huit premiers articles du flagellum ; articles 2 à 9 fusiformes (pl. ix, fig. 4), presque deux fois aussi longs que gros, striés longitudinalement dans leur moitié basale ; les articles qui suivent (pl. ix, fig. 4) sont 2 à 3 fois plus longs, et divisés par un rétrécissement en deux nodosités, dont l'inférieure est semblable aux articles 2-9, et la supérieure est plus longue, plus étroite et subcylindrique ; 14e article brisé. Ailes hyalines, parsemées de soies peu abondantes ; cubitus dépassant un peu le milieu de l'aile et confondue avec le radius ; discoïdale se bifurquant un peu après la nervure transversale, qui est très oblique et atteint le cubitus à l'origine du dernier tiers ; les deux rameaux de la fourche graduellement divergents, aboutissant l'un au-dessus, l'autre au-dessous de la pointe alaire et trois fois plus près de la pointe alaire que du rameau supérieur de la posticale ; les deux rameaux de la posticale aboutissent au bord, l'un un peu au delà, l'autre un peu en deçà, du cubitus. Fémurs et tibias non épaissis, pubescents, avec quelques poils plus longs; extrémité des tibias postérieurs avec un peigne jaune (pl. x, fig. 10), formant, au côté interne, une ligne transversale non interrompue ; métatarse antérieur presque aussi long que les quatre articles suivants réunis ; 2e article 3½ fois aussi long que gros ; 3e un peu plus de deux fois; 4e presque deux fois; 5e un peu plus long que le 4e ; sans empodium ; crochets simples. Lamelles de l'oviducte subcirculaires. Pince (pl. ix, fig. 2) à lamelle supérieure dépassant les articles basaux, largement tronquée à l'extrémité et portant à chaque angle postérieur, deux petits lobes, dont l'externe est le plus long ; articles terminaux de la pince longs, grêles, graduellement amincis et à peine arqués. Taille 1-1·2 mm.

Calcutta, Jardin Zoologique, 25-viii-07 (N. Annandale).

8. *Culicoides setiger*, sp. nov.

(Pl. x, fig. 1, aile ; fig. 2, cinq derniers articles de l'antenne du mâle ; fig. 3, partie de la pince.)

♀ ♂. Blanchâtre, dessus du thorax, antennes, et genoux bruns ; front et pleures d'un brun clair ; balanciers blancs ; bandes transversales sur le dessus de l'abdomen brunes. Yeux confluents et brièvement velus dans les deux sexes. Palpes de 4 articles cylindriques, dont le 2e est le plus long ; 3e et 4e deux fois aussi longs que gros. Bouche de la femelle non en suçoir, obtuse et courte. Antennes de 14

articles ; chez la femelle, les articles 2-6 sont subglobuleux, les trois suivants ovoïdaux ; 10-13 deux fois aussi longs que le 12e et 13e réunis, graduellement amincis au bout ; articles 2-14 avec un verticille de poils dépassant le milieu de l'article suivant. Chez le mâle (pl. x, fig. 2) les articles 2-10 sont à peine plus longs que gros ; 11-13 beaucoup plus minces, et plus longs, en forme de bouteille, trois fois aussi longs que gros ; 14e aussi gros que le 10e, trois fois aussi long que gros, pointu à l'extrémité ; poils du plumet égalant la longueur de neuf articles réunis. Ailes (pl. x, fig. 1) avec des soies alignées longitudinalement sur toute la surface ; cubitus dépassant le milieu, soudé au radius sur toute son étendue ; nervure auxiliaire dépassant à peine la transversale, qui est oblique ; discoïdale bifurquée sous la transversale, rameau supérieur droit, aboutissant à peine au-dessus de la pointe alaire ; l'inférieur aussi distant du supérieur que du rameau supérieur de la posticale, lequel est faiblement arqué et fait un angle de 45 degrés avec l'inférieur Femurs inermes, non renflés ; tibias antérieurs et postérieurs avec un peigne très fin, sous lequel se trouvent 4 ou 5 soies très grosses et disposées transversalement ; tarses densément couverts de soies ; métatarse antérieur du mâle égal aux quatre articles suivants réunis, dessus des tibias et des tarses avec des soies quatre fois aussi longues que leur grosseur ; 2e article des tarses antérieurs trois fois aussi long que gros, un peu plus long que le 3e ; 4e deux fois aussi long que gros ; 5e un peu plus mince et plus long que le 4e ; crochets simples ; sans empodium. Pince du mâle (pl. x, fig. 3) à lamelle supérieure dépassant les articles basaux, tronquée à l'extrémité, avec un faisceau de soies à chaque angle ; article terminal de la pince 5-6 fois aussi long que gros, graduellement aminci. Lamelles de l'oviducte en ellipse. Taille 1·5 mm.

Calcutta, 16-vii-07.

9. *Culicoides peregrinus*, sp. nov.

(Pl. viii, fig. 1, aile.)

♀. Noir, mat et subglabre ; antennes et thorax bruns ; balanciers blancs ; pattes brunâtres, genoux et tarses plus clairs. Bouche apte à perforer, longue, grêle et pointue ; palpes longs, avant-dernier article grossi. Articles du flagellum subglobuleux, les 5 derniers allongés et cylindriques. Ailes enfumées, plus noirâtres le long du bord antérieur, avec de nombreuses taches hyalines, dont 4 grandes au bord antérieur, à savoir, 1 oblongue occupant toute la base de l'aile, 1 transversale à l'endroit de la nervure transversale, 1 transversale à l'extrémité du radius et englobant le cubitus, 1 transversale située plus près de la pointe alaire ; les autres taches sont petites et circulaires, à savoir, 2 entre les deux rameaux de la discoïdale, 2 entre le rameau inférieur de la discoïdale et le rameau supérieur de la posticale, 2 entre les deux rameaux de la posticale, 3 entre la nervure anale et le bord ; en outre l'extrémité des deux rameaux de la discoïdale est bordée de hyalin ; surface densément couverte de soies microscopiques, avec quelques longs poils épars au tiers distal ; radius aboutissant au milieu du bord ; cubitus très rapproché du radius dans la moitié proximale, divergent avec le radius dans sa moitié distale ; 2e cellule radiales pas plus longue mais trois fois aussi large que la proximale ; nervure transversale oblique et très longue ; discoïdale bifurquée au-delà de la transversale, rameau

supérieur aboutissant un peu en dessous de la pointe alaire, faiblement arqué à la base ; l'inférieur oblitéré à la base ; bifurcation de la posticale située vis-à-vis de l'extrémité du radius ; anale simple. Pattes à poils courts ; métatarse postérieur aussi long que les trois articles suivants réunis. Abdomen allongé et déprimé. Taille 1 mm.

Côte d'Orissa ; Puri, en mars (C. Paiva).

10. *Culicoides molestus*, sp. nov.

(Pl. viii, fig. 9, aile.)

♀ ♂. Noir ; thorax brun, mat et subglabre ; antennes brunâtres, balanciers et pattes d'un blanc brunâtre. Bouche apte à perforer, longue et pointue chez le mâle comme chez la femelle. Panache du mâle peu dense, articles 3-10 pas plus longs que gros ; les suivants allongés Ailes (pl. viii, fig. 9) blanches, avec 9 taches enfumées et irrisées, dont 4 plus sombres, le long du bord postérieur et également distantes l'une de l'autre ; la 2e de ces taches est située à l'extrémité du radius, la 4e à l'extrémité du rameau supérieur de la discoïdale ; les 5 autres taches sont plus faibles, la 1e est située à l'extrémité du rameau supérieur de la posticale, la 2e entoure le rameau inférieur de la posticale ; la 3e est située sur le milieu de la tige de la posticale, la 4e sur la bifurcation de la discoïdale, la 5e entre le rameau supérieur de la discoïdale et l'extrémité du rameau supérieur de la posticale ; nervures blanches, sauf dans les taches où elles sont noires ; surface avec une ponctuation également dense, formée par des soies microscopiques, des soies plus longues sont éparses à l'extrémité distale de l'aile ; bord postérieur cilié, comme d'ordinaire ; radius dépassant un peu le milieu de l'aile ; cubitus à peine séparé du radius dans un peu plus de son tiers proximal, uni à lui par une nervure ponctiforme, divergent ensuite avec lui ; l'extrémité du cubitus est distante de celle du radius par une distance égale à la longueur de la 1e cellule radiale ; celle-ci égale à la nervure transversale, qui est oblique ; discoïdale bifurquée bien au-delà de la transversale, rameau supérieur continuant la direction de la tige ; aboutissant à la pointe alaire ; bifurcation de la posticale située au-delà de celle de la discoïdale ; anale simple. Pattes sans longs poils ; tibias antérieurs avec un éperon et probablement un peigne, les intermédiaires sans éperon ; les postérieurs avec un peigne ; métatarse antérieur égal aux trois articles suivants réunis, 4e article un peu plus long que gros, plus court que le 5e ; crochets avec quelques soies à leur base ; sans empodium ; métatarse postérieur un peu plus long que les 4 articles suivants réunis. Abdomen mat et subglabre. Taille 1 mm.

Calcutta, Jardin Zoologique, 23-viii-07 ; attaque les bœufs et les cerfs (N. Annandale).

11. *Culicoides odiosus*, sp. nov.

(Pl. viii, fig. 7, aile.)

♀. Brun ; antennes et pattes à peine brunâtres, fémurs postérieurs et tous les tibias sauf leur base, un peu plus sombres. Yeux glabres, largement confluents au vertex ; bouche apte à perforer, plus longue que la tête, en forme de long bec ; palpes

de 4 articles, dont les deux premiers sont allongés et cylindriques, le 3e et le 4e plus minces, le 3e un peu plus long que gros, le 4e aminci à sa base, aussi long que le 2e. Antennes de 14 articles ; dont le 2e est distinctement plus gros que les autres ; 3e à peine plus long que gros ; 4e et 5e de moitié, 6-9 deux fois aussi longs que gros ; les cinq derniers au moins trois fois aussi longs que gros, subcylindriques comme les précédents, le dernier un peu plus long que l'avant-dernier. Ailes (pl. viii, fig. 7) blanches avec de nombreuses taches enfumées et plus ou moins confluentes ; deux de ces taches sont noires, l'une est située sur les cellules radiales, l'autre, également au bord antérieur, entre la 1e et l'extrémité alaire ; les espaces blancs sont presque nus, avec une ponctuation à peine perceptible ; les espaces enfumés ou noirs ont une ponctuation dense, formée par des soies microscopiques, extrémité alaire avec des soies plus longues, radius depassant le milieu de l'aile ; cubitus très rapproché du radius sur toute sa longueur et réuni à lui au milieu ; transversale oblique, aussi longue qu'une des cellules radiales, discoïdale bifurquée en arrière de la transversale, son rameau supérieur continuant la direction de la tige et aboutissant à la pointe alaire ; bifurcation de la posticale située un peu au-delà de celle de la discoïdale : anale simple. Pattes sans longs poils ; les quatre tibias antérieurs sans peigne, les postérieurs avec un peigne ; tibias antérieurs avec un éperon, les quatre autres sans éperon ; tarse antérieur à peine plus long que le tibia, métatarse aussi long que les quatre articles suivants réunis, 4e article un peu plus long que gros, plus court que le 5e ; métatarse postérieur plus long que les quatre articles suivants réunis. Taille 1 mm.

Calcutta, Jardin Zoologique, 24-viii-07 (N. Annandale).

12. *Culicoides paivai*, sp. nov.

(Pl. viii, fig. 5, aile.)

♀. D'un roux clair, glabre et brillant ; pattes blanchâtres. Articles du flagellum subglobuleux ou presque transversaux, sauf le dernier. Ailes (pl. viii, fig. 5) hyalines, avec une ponctuation à peine visible, à poils alignés longitudinalement sur les nervures et entre les nervures ; cubitus atteignant le milieu de l'aile, soudé au radius sauf immédiatement avant son extrémité ; transversale presque perpendiculaire, située sur la bifurcation de la discoïdale : bifurcation de la posticale située vis-à-vis de l'extrémité du cubitus ; anale simple. Pattes sans longs poils ; métatarse aussi long que les 4 articles suivants réunis ; 4e article plus court que le 5e, un peu plus long que gros ; sans empodium distinct. Taille 1 mm.

Côte d'Orissa ; Puri, en mars (C. Paiva).

13. *Culicoides oxystoma*, sp. nov.

(Pl. ix, fig. 1, bouche et palpes.)

♀. D'un jaune brunâtre ; dessus du corps, mesosternum et antennes bruns ; pattes brunâtres, extrémité des fémurs, extrémité et base des tibias et les tarses blanchâtres ; balanciers blancs, extrémité de la massue noire. Yeux glabres, réniformes, non amincis au sommet, où ils sont distants du tiers de leur largeur. Bouche apte à perforer (pl. ix, fig. 1), longue, étroite, composée de quatre pièces

sublinéaires, amincies au bout et d'égale longueur ; deux de ces pièces sont glabres et brunes, l'une dentelée au quart apical: les deux autres pièces sont pubescentes; palpes de 4 articles, dont le 1er est subcylindrique et 4 à 5 fois aussi long que gros, le 2e un peu plus court que le 1er, élargi en triangle un peu au-dessus du milieu : 3e et 4e petits. Antennes composées de 14 articles, munis d'un court verticille de soies; articles 2 à 5 subglobuleux, 6 à 9 subellipsoïdaux, les 5 derniers allongés, cylindriques, un peu plus de deux fois aussi longs que gros, le dernier de moitié plus long que l'avant-dernier. Ailes avec des poils microscopiques qui les font paraitre ponctuées, et quelques soies aux environs du bord de l'extrémité alaire ; surface sombre, avec plusieurs taches hyalines, qui sont complètement dépourvues de soies et de points, à savoir : une tache avant et une après les cellules radiales, une autre avant l'extrémité, une à la pointe alaire à l'extrémité du rameau supérieur de la discoïdale, deux dans la fourche de la discoïdale, une sous l'extrémité du rameau inférieur de la discoïdale, une dans la fourche de la posticale ; en outre la base de l'aile est plus ou moins hyaline et glabre sauf le bord supérieur ; la région des cellules radiales est plus fortement assombrie, presque noire, et forme une tache stigmatique. Cubitus dépassant un peu le milieu de l'aile, très rapproché du radius, avec lequel il est réuni un peu avant son milieu, par une nervure ponctiforme ; radius aboutissant à l'extrémité du cubitus ; nervure transversale très oblique ; discoïdale se bifurquant en arrière de la transversale, à une distance plus longue que la transversale, rameau supérieur aboutissant à la pointe alaire, l'inférieur à égale distance de la pointe alaire et du rameau supérieur de la posticale ; ce dernier court et fortement arqué ; bifurcation de la posticale située en-dessous de l'extrémité du cubitus. Pattes finement pubescentes ; fémurs et tibias à soies éparses ; tibias postérieurs avec un peigne, les autres sans peigne ; articles 1-4 des tarses antérieurs ayant sur le dessous, à l'extrémité, deux soies juxtaposées et plus fortes que les autres soies qui sont denses ; métatarse antérieur presque égal aux quatre articles suivants réunis ; 2e trois fois aussi long que gros ; 3e deux fois ; 4e à peine plus long que gros, pas plus court que le 5e ; crochets simples ; empodium nul. Lamelles de l'oviducte à peine plus longues que larges. Taille 1·9 mm.

Calcutta, 25-viii-07, Jardin Zoologique ; pique les bœufs et les cerfs (Annandale).

3e Genre, Palpomyia, Megerle.

1. Au moins les fémurs antérieurs spinuleux .. 2.
   Tous les fémurs inermes (subgenus *Sphæromyas*, Curt. = *Johannseniella*, Willist.) .. 8.
2. Dernier article tarsal inerme ; articles 3 et 4 pas plus longs que gros ; crochets tarsaux petits, simples et égaux ; fémurs postérieurs et intermédiaires non spinuleux (*Palpomyia*) .. .. .. 1. *P. burmæ*, sp. nov.
   Dernier article de tous les tarses armé, sur le dessous, de longs appendices noirs qui

	le font paraitre spinuleux ; 3[e] article et souvent encore le 4[e] beaucoup plus longs que gros ; crochets tarsaux longs, au moins en partie ; fémurs postérieurs toujours spinuleux	3.
3.	Fémurs intermédiaires inermes ; 5 derniers articles antennaires quatre fois aussi longs que le 9[e]	4.
	Tous les fémurs spinuleux	5.
4.	Crochets antérieurs inégaux, l'un bifide et long, l'autre court et avec une dent basale ; crochets intermédiaires et postérieurs inégaux, tous avec une dent basale ; 4[e] article deux fois aussi long que gros ..	2. *P. filicornis*, sp. nov.
	Crochets antérieurs égaux, longs, avec une dent basale, les 4 autres inégaux, avec une dent basale ; tarses postérieurs presque doubles du tibia	6 *P. interrupta*, sp. nov.
5.	Crochets égaux, longs et simples ..	5. *P. pictipes*, sp. nov.
	Crochets inégaux à toutes les pattes ..	6.
6.	Tous les crochets d'égale longueur, l'un simple, l'autre avec une dent basale ..	3. *P. cinerea*, sp nov.
	Tous les crochets simples, mais de longueur inégale, l'un plus long ou aussi long que l'article, l'autre dépassant à peine la moitié de l'article	7.
7	Tous les tibias annelés de noir	4. *P. pulchripes*, sp. nov.
	Tibias sans anneau noir	7. *P. inæqualis*, sp. nov.
8.	Ailes avec deux taches noires ; 5[e] article tarsal inerme	9.
	Ailes sans tache	10.
9.	Discoïdale bifurquée avant la transversale ; crochets des tarses antérieurs longs et égaux, ceux des 4 autres tarses de longueur inégale	8. *P.* (*S.*) *bisignata*, sp. nov.
	Discoïdale bifurquée trés en arrière de la transversale ; crochets petits et simples ..	9. *P.* (*S.*) *bimacula*, sp. nov.
10.	Dernier article de tous les tarses spinuleux dessous ; tarses postérieurs deux fois aussi longs que les tibias, crochets antérieurs longs, égaux, avec une dent basale, les autres de longueur inégale, avec une dent basale	10. *P.* (*S.*) *filitarsis*, sp. nov.

Dernier article tarsal inerme ; tarses postérieurs guère plus longs que les tibias ; crochets égaux et simples .. .. 11.

11. Discoïdale bifurquée sous la transversale ; corps noir ; crochets petits, égalant le tiers de l'article .. .. .. 11. *P. (S.) albiditarsis*, sp. nov.

Discoïdale bifurquée bien en arrière de la transversale ; abdomen vert ; crochets longs, plus longs que l'article .. 12. *P. (S.) viridiventris*, sp. nov.

1. *Palpomyia burmæ*, sp. nov.

♀. Noir ; face, palpes et premier article antennaire roux, reste des antennes brun ; tiers antérieur de l'abdomen, hanches et pattes d'un jaune roussâtre ; genoux, extrémité des tibias et 2 ou 3 derniers articles tarsaux d'un brun noir. Yeux séparés au vertex par une ligne brillante et noire. Antennes filiformes, tous les articles cylindriques, sauf le basal ; 2e trois fois aussi long que gros ; les suivants deux fois ; les 5 derniers deux fois aussi longs que le 9e. Thorax glabre et brillant. Ailes hyalines ; radius dépassant de beaucoup le milieu de l'aile, sa partie proximale à peine plus longue que la partie distale ; la partie basale du cubitus à peine plus courte que la 2e partie ; 3e partie 4 à 5 fois aussi longue que la 2e, son extrémité un peu plus éloignée de la pointe alaire que le rameau postérieur de la discoïdale ; rameau antérieur de la discoïdale droit, aboutissant à la pointe alaire ; bifurcation de la discoïdale située bien en arrière de la transversale, vis-à-vis de celle de la posticale ; extrémité du rameau antérieur de la postérieur un peu plus rapprochée de la pointe alaire que l'extrémité du radius. Fémurs guère plus gros que les tibias, les antérieurs un peu plus gros que les autres, avec 9-10 spinules noires ; tibias antérieurs plus courts que le tarse, métatarse égalant presque les 4 articles suivants réunis ; tibias postérieurs aussi longs que le tarse, avec un peigne double ; métatarse postérieur $1\frac{1}{2}$ fois aussi long que les 4 articles suivants réunis ; à toutes les pattes, le 3e article tarsal est à peine aussi long que gros, le 4e transversal et tronqué obliquement, le 5e plus long que le 3e et le 4e réunis, inerme, avec deux crochets petits, égaux et simples ; partie ventrale des articles 1 et 2 avec deux rangées de soies bulbeuses. Taille 2 mm.

Sur les herbes, à la base des Dawna Hills, L. Burma, en mars.

2. *Palpomyia filicornis*, sp. nov.

(Pl. x, fig. 4, deux derniers articles des tarses antérieurs ; fig. 5, aile ; fig. 6, crochets des 4 tarses postérieurs ; fig. 7, soies bulbeuses du métatarse postérieur ; fig. 9, tête et antenne.)

♀. D'un brun noir ; tête, antennes, hanches, pattes et lamelles de l'oviducte jaunes, dernier article tarsal, genoux, surtout ceux des pattes postérieures noirs ;

ventre d'un brun clair ; balanciers bruns. Yeux glabres. Bouche proéminente, en suçoir, formée par trois pièces sublinéaires, dont l'une est dentelée en scie. Palpes de 4 articles cylindriques, dont le 2e est aussi long que les deux derniers réunis ; articles 1, 3 et 4 environ deux fois aussi longs que gros. Antennes (pl. x, fig. 9) filiformes, atteignant la moitié de la longueur du corps, avec une pilosité deux fois aussi longue que l'épaisseur des articles ; second article presque deux fois aussi long que le 3e ; articles 3-9 obconiques, 2 à 3 fois aussi longs que gros ; articles 10-14 longuement cylindriques, chacun d'eux égal aux articles 5 à 9 réunis. Ailes à surface ponctuée et à bords ciliés (pl. x, fig. 5) ; radius atteignant le milieu de l'aile ; cubitus atteignant le dernier quart de l'aile, réuni par une courte transversale à l'extrémité du radius, discoïdale bifurquée un peu avant sa rencontre avec la transversale ; rameau supérieur aboutissant en dessous de la pointe alaire ; rameau supérieur de la posticale faiblement arqué et continuant la direction de la tige ; nervure anale bifurquée, rameau supérieur parallèle au bord alaire. Fémurs antérieurs avec quatre spinules noires, dans leur moitié apicale ; fémurs intermédiaires inermes ; fémurs postérieurs avec trois spinules dans leur tiers apical ; extrémité des tibias sans peigne ; métatarse antérieur presque double du 2e article, qui est un peu plus long que les articles 3 et 4 réunis ; 3e article égal au 4e, deux fois aussi long que gros ; 5e article au moins aussi long que le 2e ; sur le dessous, le métatarse de toutes les pattes porte deux rangées de soies bulbeuses, c'est à dire de soies brunes, à base renflée en vessie (pl. x, fig. 7) ; le 5e article de toutes les pattes porte sur le dessous, deux rangées de 5 lamelles linéaires, noires, deux à trois fois aussi longues que l'épaisseur du tarse (pl. x, fig. 4) ; empodium nul ; crochets des tarses antérieurs inégaux (pl. x, fig. 4) et noirs ; l'un bifide et presque aussi long que l'article tarsal ; l'autre court, avec une dent basale ; ceux des quatre autres pattes inégaux et noirs (pl. x, fig. 6) ; l'un grand avec une dent basale ; l'autre court, et avec une dent basale. Poils des pattes peu longs. Lamelles de l'oviducte guère plus longues que larges. Taille, ♀, 4 mm.

Calcutta, 16-vii-07 (Annandale).

3. *Palpomyia cinerea*, sp. nov.

♀. D'un noir mat, avec un reflet cendré ; front, neuf premiers articles antennaires et pattes d'un jaune roussâtre ; face et reste des antennes d'un brun noir ; hanches cendrées ; extrémité des 4 fémurs antérieurs et des 4 tibias antérieurs, fémurs postérieurs sauf leur base et un large anneau avant l'extrémité, et tibias postérieurs sauf un large anneau avant l'extrémité, noirs, tarses d'un jaune blanchâtre ; balanciers d'un jaune brunâtre. Tête très transversale vue d'en haut, 2-3 fois aussi haute que longue étant vue de côté ; yeux glabres et largement confluents, un peu échancrés près des antennes ; bec égal au tiers de la hauteur de la tête ; palpes courts, de 4 articles, ne dépassant pas le bec. Article 2e des antennes un peu plus long que le 3e ; articles 3-9 de moitié plus longs que gros ; 10-14 plus longs, deux fois aussi longs que le 9e ; tous à poils 2-3 fois aussi longs que leur épaisseur. Thorax très convexe, plus haut que long, bord antérieur un peu plus

haut que le vertex ; mesonotum parsemé de points noirs portant de minimes soies dressées ; quatre bandes noires et minces, les deux médianes confluentes en avant et occupant la moitié antérieure du mesonotum, les deux externes occupant la moitié postérieure du mesonotum Ailes hyalines, sans poils ; nervures jaunes, costale, radius, cubitale et les transversales d'un brun noir ; radius aboutissant un peu avant le tiers distal de l'aile, ses deux parties égalent la moitié du cubitus, qui forme avec elles et avec le bord deux cellules linéaires, également minces, dont la 2^{e} est un peu plus de deux fois aussi longue que la proximale ; partie distale du radius à peine plus courte que la partie proximale ; le cubitus est séparé de la pointe alaire par une distance plus courte que sa partie proximale ; costale non prolongée au-delà du cubitus ; discoïdale bifurquée à l'endroit de la transversale, qui est perpendiculaire, rameau supérieur aboutissant à la pointe alaire, extrémité du rameau inférieur aussi rapprochée de la pointe alaire que le cubitus ; bifurcation de la postcale très éloignée distalement de la transversale, rameau supérieur continuant la direction de la tige, l'inférieur faiblement arqué ; nervure anale bifurquée et peu marquée. Fémurs subcylindriques, avec 10-12 petites spinules noires situées sur le dessous, dans la moitié distale ; fémurs et tibias avec des poils un peu plus longs que leur épaisseur ; tarses bien plus minces que les tibias ; métatarse antérieur égal à la moitié du tibia, aussi long que les trois articles suivants réunis ; 3^{e} article deux fois aussi long que gros ; 4^{e} pas plus long que gros ; 5^{e} au moins aussi long que le 3^{e} et le 4^{e} réunis, avec 5 paires de longues spinules noires, sur le dessous ; crochets tarsaux d'égale longueur, à peine plus courts que l'article tarsal, l'un avec une dent à sa base, qui atteint le quart de sa longueur ; tarses postérieurs un peu plus longs que le tibia ; métatarse d'un tiers plus court que le tibia, ègal aux 4 articles suivants réunis, avec des soies bulbeuses et alignées sur le dessous ; les autres articles et les crochets tarsaux, ainsi que les tarses intermédiaires sont conformés comme aux pattes antérieures. Abdomen allongé, déprimé et linéaire. Taille 2·5 mm.

Rajmahal, Bengale, 3-vii-07.

4. *Palpomyia pulchripes*, sp. nov.

(Pl. xi, fig. 8, aile.)

♀. Noir mat, avec un reflet cendré ; front, face, palpes, 9 premiers articles antennaires, hanches, pattes et balanciers d'un jaune roussâtre ; un large anneau avant l'extrémité des 4 tibias antérieurs, les 4 genoux antérieurs, moitié distale des fémurs postérieurs et un large anneau au milieu des tibias postérieurs, noirs. Tête comme chez les précédents, yeux largement confluents. Article 2^{e} des antennes de moitié plus long que le 3^{e} ; articles 3-9 graduellement allongés, le 3^{e} de moitié plus long que gros, le 9^{e} 2½ fois ; articles 10-14 filiformes, plus de deux fois le 9^{e} ; poils 2-3 fois aussi longs que la grosseur des articles. Thorax convexe, avec un vestige de 3 bandes longitudinales, dont la médiane occupe la moitié antérieure du mesonotum et est bifide en arrière, les externes occupent la moitié postérieure ; bord antérieur situé plus haut que le vertex. Ailes hyalines, finement ponctuées, dépassant un peu l'abdomen ; costale, sous-costale, radius, cubitus, partie proximale de la discoïdale et

la transversale d'un brun noir ; partie distale du radius à peine plus courte que la partie proximale ; son extrémité située au-delà du milieu de l'aile ; la 1e cellule radiale dépasse un peu le tiers de la distale ; extrémité du cubitus à peine plus distante de la pointe alaire que celle du rameau inférieur de la discoïdale, rameau supérieur aboutissant à la pointe alaire ; discoïdale bifurquée un peu avant la transversale ; posticale bifurquée très en arrière de la transversale ; anale bifurquée. Pattes antérieures un peu plus grosses que les intermédiaires, leurs fémurs plus longs que la hauteur du thorax, tous les fémurs avec 15-20 spinules noires, dans leur moitié distale ; tibias un peu plus courts que les tarses, les postérieurs longuement ciliés en dehors, métatarse un peu plus long que la moitié du tibia, le postérieur avec des soies bulbeuses et alignées ; 4e article pas plus long que gros ; 5e plus long que le 3e et le 4e réunis, avec 5 paires de spinules noires, sur le dessous à toutes les pattes ; crochets tarsaux inégaux et simples, le long égale l'article tarsal, le petit est d'un tiers plus court. Abdomen sans reflet cendré, d'un noir brillant, sublinéaire. Taille 3 mm.

Calcutta, 13-viii-07 ; N. Bengale : Purneah, 6-viii-07.

5. *Palpomyia pictipes*, sp. nov.

♀. Semblable au précédent, dont il diffère par les caractères suivants : tarses blanchâtres ; extrémité des 4 fémurs antérieurs et de leurs tibias, fémurs et tibias postérieurs sauf unl arge anneau avant l'extrémité, noirs ; de chaque côté de la bande médiane du mesonotum se voit une petite tache circulaire. Mesonotum faiblement pubescent. Partie distale du radius égale à la moitié de la partie proximale ; transversale noire et bordée de brun. Fémurs antérieurs pas plus longs que la hauteur du thorax, crochets tarsaux égaux, aussi longs que l'article tarsal. Taille 3 mm.

Calcutta, 15-viii-07 ; distr. Purneah : Katihar, 4-viii-07.

6. *Palpomyia interrupta*, sp. nov.

(Pl. xi, fig. 16, crochets des tarses antérieurs.)

♀. Noir ; vertex, front, face, palpes, 9 premiers articles antennaires et pattes sauf les hanches et les genoux, d'un jaune roussâtre ; balanciers noirs, base du pétiole rousse. Tête, bouche et palpes comme chez les précédents, sauf que les yeux ne sont pas confluents mais interrompus par une mince bande rousse. Article 2e des antennes deux fois aussi long que le 3e ; 3-9 cylindriques, au moins de moitié plus longs que gros, 10-14 filiformes quatre fois aussi longs que le 9e ; poils 2-3 fois aussi longs que l'épaisseur des articles. Thorax très convexe, luisant, glabre, finement ponctué. Ailes hyalines, dépassant d'un tiers l'abdomen ; costale, sous-costale, radius, cubitus, partie proximale de la discoïdale et la transversale d'un brun noir, les autres nervures pâles ; extrémité du radius dépassant le milieu de l'aile, partie distale de cette nervure dépassant à peine la moitié de la partie proximale ; 1e cellule radiale égale au tiers de la 2e, toutes deux sublinéaires ; extrémité du cubitus à peine plus rapprochée de la pointe alaire que l'extrémité du rameau inférieur de la discoïdale ; rameau supérieur de la discoïdale aboutissant assez près de la pointe alaire ; bifurcation de la discoïdale située à l'endroit de la transversale, celle de la posticale située un peu en avant de la

transversale; anale bifurquée. Fémurs antérieurs plus gros que les intermédiaires, moins gros que les postérieurs; les antérieurs et les postérieurs avec 4-5 paires de spinules au tiers distal, les intermédiaires inermes; tarses antérieurs à peine plus longs que le tibia; métatarse égal aux 3 articles suivants réunis, 4e pas plus long que gros: 5e égal au 2e, avec 6 paires de spinules sur le dessous; crochets tarsaux égaux, d'un tiers plus courts que l'article tarsal, avec une dent basale atteignant le quart de leur longueur (pl. xi, fig. 16); aux pattes intermédiaires, le métatarse égale les 4 articles suivants réunis; 4e article pas plus long que gros; 5e plus long que le 3e et le 4e réunis, avec 6 paires de spinules; crochets tarsaux inégaux, l'un est égal aux $\frac{2}{3}$ de l'article, l'autre à un tiers de l'article, tous deux avec une dent basale; aux pattes postérieures, le métatarse est un peu plus long que les 3 articles suivants réunis; 4e article deux fois aussi long que gros; 5e égal aux 3e et 4e réunis, avec 6 paires de spinules, crochets inégaux, l'un égal aux $\frac{3}{4}$ de l'article, l'autre égal au tiers du grand crochet, tous deux avec une dent basale; les tarses postérieurs dépassent de $\frac{2}{3}$ la longueur du tibia. Abdomen luisant, allongé. Taille 3 mm.

Calcutta, 10, 14, 27-vii (12 exemplaires).

7. *Palpomyia inæqualis*, sp. nov.

♀. Noir; pattes rousses, sauf la moitié distale des fémurs, l'extrême base des quatre tibias antérieurs, les tibias postérieurs en entier et les quatre hanches postérieures; front, les 9 premiers articles antennaires et le prosternum d'un roux brun; balanciers testacés. Bouche en bec, égale au tiers de la hauteur de la tête; yeux largement confluents au vertex. Articles antennaires 2-9 subcylindriques, de moitié plus longs que gros; articles 10-14 deux fois aussi longs que le 9e; poils comme d'ordinaire. Thorax mat et cendré. Ailes hyalines, nervures pâles; le radius dépasse le milieu de l'aile, sa partie distale est à peine plus longue que la moitié de sa partie proximale; les deux cellules radiales sont linéaires, la 2e presque trois fois aussi longue que la 1e; extrémité du cubitus à peine plus rapprochée de la pointe alaire que le rameau inférieur de la discoïdale; bifurcation de la discoïdale située un peu avant la transversale, celle de la posticale située bien au delà de la transversale; anale bifurquée. Fémurs distinctement plus gros que les tibias, avec 5-6 spinules dans leur tiers distal; fémurs antérieurs plus courts que les quatre autres; tibias antérieurs sans peigne, à peine plus courts que les tarses; 4e article tarsal presque deux fois aussi long que gros; 5e aussi long que le 3e et le 4e réunis, avec six paires de spinules sur le dessous; les crochets tarsaux de toutes le pattes sont simples et inégaux, l'un plus long que l'article tarsal, l'autre dépassant à peine la moitié de l'article tarsal; tibias postérieurs ciliés en dehors. Abdomen brillant et allongé. Taille 3 mm.

N. Bengal: Purneah, 5-viii.

8. *Palpomyia* (*Sphæromyias*) *bisignata*, sp. nov.

(Pl. xi, fig. 1, deux derniers articles des tarses postérieurs.)

♀. Noir brillant; vertex, front, 9 premiers articles antennaires, prosternum, hanches et fémurs des 4 pattes antérieures et l'extrémité des fémurs postérieurs

d'un roux jaunâtre ; deux premiers articles des tarses antérieurs, quatre premiers des autres tarses, blanchâtres. Tête conformée comme chez le précédent, sauf que la bouche n'est pas en bec, mais obtuse, atteignant le tiers de la hauteur de la tête, et dépassée par les palpes qui se composent de 4 articles ; yeux glabres, sinueux, non confluents au vertex, où ils sont distants d'un espace égal à la largeur de leur tiers supérieur. Articles antennaires 2-9 deux fois aussi longs que gros ; 10-14 filiformes, deux fois aussi longs que le 9^{e} ; poils deux fois aussi longs que l'épaisseur des articles. Thorax à soies dressées, petites et éparses. Ailes hyalines, avec deux taches carrées d'un brun noir, dont la plus grande s'étend du bord antérieur par la transversale jusqu'à la discoïdale ; l'autre est située à l'extrémité du cubitus ; radius noir, touchant presque le bord costal, dépassant le milieu de l'aile ; à peine avant son extrémité, il est relié au cubitus par une transversale ; 1^{e} cellule radiale plus large que la distale, dont elle atteint le tiers en longueur ; cubitus noir, distant de la pointe alaire de deux fois la longueur de la 1^{e} cellule radiale ; discoïdale noire, bifurquée avant la transversale, son rameau supérieur aboutit presque à la pointe alaire, l'inférieur est un peu plus rapproché de la pointe de l'aile que le cubitus ; bifurcation de la posticale située sous la transversale ; anale non bifurquée. Pattes postérieures plus grosses et plus longues que les 4 antérieures ; fémurs et tibias faiblement ciliés, les fémurs non spinuleux ; tibias postérieurs avec deux peignes, dont l'un est deux fois aussi long que l'autre, mais moins dense ; tarses antérieurs un peu plus longs que le tibia ; métatarse égal aux 3 articles suivants réunis ; 3^{e} article pas plus long que gros ; 4^{e} un peu transversal ; 5^{e} inerme, un peu plus long que le 3^{e} et le 4^{e} réunis, fortement grossi, subfusiforme ; crochets égaux, atteignant les $\frac{2}{3}$ de l'article tarsal ; aux 4 autres pattes, les crochets sont inégaux, l'un atteint la base du 4^{e} article, l'autre le tiers basal du 5^{e} article ; la base du 5^{e} article aux 4 pattes postérieures porte sur sa partie dorsale un bourrelet avec un groupe de fortes soies noires, plus longues que la grosseur de l'article ; base du métatarse postérieur arquée, partie ventrale avec des soies bulbeuses et alignées (pl. xi, fig. 1). Taille 2·5 mm.

N. Bengale : Purneah, 5-viii (C. Paiva).

9. *Palpomyia* (*Sphæromyias*) *bimacula*, sp. nov.

(Pl. xi, fig. 5, trois derniers articles des tarses postérieurs ; fig. 7, aile.)

♂. D'un roux brun ; 1er article antennaire roux ; moitié proximale du flagellum et du plumet jaune, moitié distale noire ; palpes sombres ; metanotum et balanciers sauf la tige, noirs ; hanches et pattes blanchâtres ; anneau avant l'extrémité des 4 fémurs postérieurs et l'extrémité de leurs tibias, noirs ; abdomen blanchâtre, sauf la moitié postérieure du dessus, qui est d'un roux brun, et le bord postérieur des sternites qui est noir. Yeux confluents au vertex ; palpes allongés. Articles du flagellum aussi gros que longs, les 5 derniers filiformes. Ailes hyalines (pl. xi, fig. 7) avec deux taches petites, transversales et d'un brun noir, dont l'une couvre la nervure transversale et la base du cubitus, l'autre est située à l'extrémité du cubitus ; radius pas plus long que la nervure auxiliaire, aboutissant au-delà du milieu de l'aile ; cubitus droit, distant de l'extrémité alaire de toute sa longueur, 1^{e} et 2^{e} parties du

radius très courtes, plus courtes que la transversale ; cellule radiale proximale en forme d'aréole très petite et peu distincte; transversale aboutissant à l'origine du cubitus; bifurcation de la discoïdale plus rapprochée de l'extrémité que de la base du cubitus, fourche par suite longuement pétiolée ; rameau supérieur de la discoïdale aboutissant à la pointe de l'aile ; bifurcation de la posticale située vis-à-vis de celle de la discoïdale, extrémité du rameau supérieur un peu plus rapprochée de la pointe alaire que le cubitus; nervure anale non bifurquée. Pattes non renflées ni spinuleuses ; tibias antérieurs plus longs que le métatarse, qui est égal aux 4 articles suivants réunis ; 3e et 4e articles de tous les tarses cordiformes, pas plus longs que gros ; 5e plus mince, égal aux 3e et 4e réunis ; pattes intermédiaires plus longues et plus minces, leur métatarse presque égal au tibia, de moitié plus long que les 4 articles suivants réunis ; métatarse postérieur plus court que le tibia, égal aux 3 articles suivants réunis ; crochets petits, pas plus longs que la grosseur de l'article, simples et égaux (pl. xi, fig. 5) ; tibias postérieurs avec un double peigne, dessous des deux premiers articles des tarses postérieurs avec deux rangées de soies bulbeuses. Abdomen grêle et allongé, presque deux fois aussi long que le reste du corps. Taille 1·6 mm.

Calcutta, 14-viii (N. Annandale) ; N. Bengal: Purneah, 5-viii (C. Paiva).

10. *Palpomyia* (*Sphæromyias*) *filitarsis*, sp. nov.

(Pl. xi, fig. 9, crochets des tarses antérieurs.)

♀. Noir mat; face, front, palpes et 9 premiers articles antennaires roux ; 4 premiers articles de tous les tarses blanchâtres; fémurs antérieurs d'un roux brunâtre ainsi que leurs hanches et leurs trochanters; balanciers d'un brun noir. Tête, bec et palpes conformés comme chez *Palpomyia cinerea* ; yeux séparés au vertex par une ligne étroite. Article 2e des antennes plus long que le 3e ; 3-9 sub-globuleux ; 10-14 trois fois aussi longs que le 9e, tous à poils 2-3 fois aussi longs que leur épaisseur. Thorax très convexe, glabre, faiblement luisant et finement ponctué. Ailes hyalines, finement ponctuées ; costale, radius, cubitus, partie proximale de la discoïdale et les 2 transversales d'un brun noir, les autres nervures très pâles ; partie distale du radius égalant à peine la moitié de la partie proximale, son extrémité située au delà du milieu de l'aile ; 2e cellule radiale un peu plus de trois fois aussi longue que la proximale ; l'extrémité du cubitus est aussi éloignée de la pointe alaire que l'extrémité du rameau inférieur de la discoïdale ; bifurcation de la discoïdale située un peu avant la transversale, celle de la posticale est située en-dessous de la transversale; anale bifurquée. Fémurs glabres et inermes. Tibias des 4 pattes antérieures avec un peigne jaune ; métatarse égal à la moitié du tibia ; 4e article à peine plus long que gros ; 5e plus long que le 3e et le 4e réunis, avec 4-5 paires de spinules. Fémurs et tibias des pattes postérieures beaucoup plus longs et plus gros que les 4 antérieurs, les fémurs un peu sinueux sur le dessus au milieu, tarses postérieurs très minces et deux fois aussi longs que le tibia, métatarse plus ong que le tibia, 4e article encore 5-6 fois aussi long que gros, égal à la moitié du 5e, qui porte 5 paires de spinules noires sur le dessous ; crochets tarsaux des pattes antérieures égaux, égalant environ

la longueur de l'article, avec une courte dent basale (pl. xi, fig. 9), ceux des tarses postérieurs sont très inégaux, l'un très long, égalant presque l'article, l'autre très court, égal au $\frac{1}{5}$ de l'article, tous deux avec une dent basale qui simule un petit crochet ; les crochets des tarses intermédiaires sont conformés comme ceux des tarses postérieurs, mais moins longs. Abdomen allongé, distinctement rétréci à sa base. Taille 3 mm.

Calcutta, 3, 11, 13-viii (11 exemplaires). Cette espèce est proche de *Macropeza*, dont elle diffère, par la transversale qui relie la 1^e^ longitudinale au cubitus.

11. *Palpomyia* (*Sphæromyias*) *albiditarsis*, sp. nov.

♀. Noir et mat ; balanciers blancs ; tarses blanchâtres ; front, face et 1^er^ article antennaire (le reste des antennes brisé), d'un roux sombre. Bouche en forme de bec court égalant le quart de la hauteur de la tête ; yeux glabres, séparés seulement par une ligne. Thorax glabre. Ailes hyalines ; transversale noire, bordée de brunâtre, un peu oblique ; radius dépassant le milieu de l'aile ; sa partie distale égale au tiers de la partie proximale ; extrémité du cubitus éloignée de la pointe alaire, à peine plus rapprochée d'elle que le rameau supérieur de la posticale ; les 2 cellules radiales linéaires, également minces, la distale d'un tiers plus longue que la proximale ; discoïdale bifurquée sous la transversale, son rameau supérieur aboutit presque à la pointe alaire ; bifurcation de la posticale située bien au delà de la transversale ; anale bifurquée. Pattes antérieures brisées, fémurs des 4 autres inermes ; tibias postérieurs assez longuement ciliés en dehors, un peu plus courts que les tarses ; métatarse postérieur avec des soies bulbeuses et alignées, égal aux articles 2 et 3 réunis ou à la moitié du tibia, 3^e^ article deux fois aussi long que gros, 4^e^ pas plus long que gros ; 5^e^ article des 4 pattes postérieures sans spinules, au moins égal aux articles 3 et 4 réunis, crochets égaux, simples, atteignant le tiers de la longueur de l'article tarsal. Abdomen sublinéaire. Taille 2 mm.

Calcutta.

12. *Palpomyia* (*Sphæromyias*) *viridiventris*, sp. nov.

(Pl. viii, fig. 8, derniers articles des tarses postérieurs.)

♀. Brun, mat, et glabre, antennes et pattes d'un jaune brunâtre ; abdomen d'un vert clair ; balanciers d'un brun noir, leur pétiole testacé. Yeux confluents. Articles du flagellum cylindriques, 2-3 fois aussi longs que gros, les 5 derniers deux fois aussi longs que le 9^e^ ; poils 2-3 fois aussi longs que l'épaisseur des articles. Ailes subhyalines et glabres ; le radius aboutit au bord vers le milieu de l'aile, le cubitus avant le quart distal ; 2^e^ partie du cubitus à peine plus longue que le tiers de la 3^e^, un peu plus longue que la transversale, qui est elle-même un peu plus longue que la 1^e^ du cubitus ; extrémité du radius unie au cubitus par une transversale parallèle et égale à la 1^e^ partie du cubitus ; fourche de la discoïdale pétiolée, le pétiole un peu plus long que la transversale, rameau supérieur relevé à sa base ; bifurcation de la posticale située en-dessous de celle de la discoïdale, nervure anale non bifurquée ; toutes les nervures brunes ; lobe anal arrondi. Fémurs non

épaissis ni spinuleux ; métatarse postérieur plus court que le tibia, deux fois aussi long que les 4 articles suivants réunis, article 3e un peu plus long que gros ; 4e transversal et cordiforme ; 5e plus long que le 3e et le 4e réunis, sur le dessous il est élargi vers le milieu et découpé à la base (pl. viii, fig. 8) ; métatarse antérieur à peine plus long que les 4 articles suivants réunis, ceux-ci conformés comme aux pattes postérieures ; crochets simples, égaux, plus longs que l'article Taille 1·5 mm.

Dawna Hills, altitude de 1,000 m. (L. Burma) ; mars.

4e Genre, Bezzia, Kieffer.

1.	Fémurs dépourvus de spinules ; crochets tarsaux égaux	2.
	Fémurs armés de spinules sur le dessous ; crochets simples	6.
2.	Article dernier des tarses postérieurs armé de lougues spinules noires sur son dessous ; crochets aussi longs que les deux tiers de l'article, avec une dent basale qui atteint le tiers de leur longueur	3.
	Article dernier des tarses postérieurs sans spinules ; crochets petits et simples ..	4.
3.	Les deux premiers articles des tarses postérieurs avec deux rangées de soies bulbeuses sur leur dessous	5. *B. nigricans*, sp. nov.
	Seulement le métatarse postérieur avec des soies bulbeuses	4. *B. lacteipennis*, sp. nov.
4.	Yeux trés larges, la face et le front ne formant qu'une ligne longitudinale ..	3. *B. facialis*, sp. nov.
	Face et front plus larges que haut ..	5.
5.	Radius dépassant notablement le milieu de l'aile	2. *B. gracilipes*, sp. nov.
	Radius atteignant le milieu de l'aile ..	1. *B. flaviventris*, sp. nov.
6.	Crochets tarsaux petits, égaux, atteignant le tiers de l'article	6. *B. armatipes*, sp. nov.
	Crochets tarsaux longs, inégaux, l'un aussi long que l'article, l'autre d'un tiers plus court que l'article	7. *B. rufiventris*, sp. nov.

1. *Bezzia flaviventris*, sp. nov.

♀. Face, scape, quatre hanches postérieures, et toutes les pattes d'un jaune clair ; balanciers d'un blanc de lait ; flagellum et hanches antérieures d'un brun noir ; occiput et thorax bruns ; genoux et extrémité des tibias noirs ; abdomen d'un jaune clair, dessus des deux premiers segments et, sur les autres segments, une large tache

échancrée au milieu du bord postérieur, noirs. Yeux séparés au vertex par une ligne brune. Articles du flagellum globuleux, les quatre derniers 2-3 fois aussi longs que gros, cylindriques, le 14e pas plus long mais plus gros que les précédents. Mesonotum mat et glabre. Ailes d'un blanc de lait, à nervures d'un jaune pâle ; radius atteignant le milieu de l'aile, à peine plus rapproché de la pointe alaire que le rameau inférieur de la posticale ; cubitus distant du bord, presque droit, plus de deux fois aussi long que le radius, son extrémité aussi distante de la pointe alaire que le rameau inférieur de la discoïdale ; rameau supérieur de la discoïdale aboutissant à peine en dessous de la pointe alaire ; bifurcation de la discoïdale située en deçà de la transversale, bifurcation de la posticale à peine au delà de la transversale. Pattes sans longs poils et sans spinules ; tibias antérieurs aussi longs que le tarse, métatarse égal aux quatre articles suivants réunis, 3e article deux fois aussi long que gros, 4e à peine plus long que gros, tronqué obliquement à l'extrémité, 5e égal aux deux précédents réunis, sans appendices spinuleux ; crochets de toutes les pattes simples, petits, aussi longs que le tiers de l'article tarsal, métatarse postérieur égal à la moitié du tibia, avec deux rangées de soies bulbeuses sur sa partie ventrale. Abdomen faiblement déprimé, un peu plus long que le reste du corps. Taille 1·6 mm.

Noalpur, Nepal, en février.

2. *Bezzia gracilipes*, sp. nov.

♀. Noir mat ; thorax d'un roux marron ; antennes et pattes d'un jaune rous sâtre. Article 2e des antennes à peine plus long que le 3e ; 3-9 subcylindriques, un peu plus longs que gros, verticilles deux fois aussi longs que l'épaisseur des articles ; 10-14 deux fois aussi longs que le 9e, à poils plus courts que ceux du 9e. Nervation comme chez *rufiventris* surface densément ponctuée. Pattes grêles ; fémurs à peine plus gros que les tibias, subglabres et inermes ; tibias à poils dressés et peu longs ; tarses guère plus minces et guère plus longs que les tibias, métatarse antérieur égal aux articles 2 et 3 réunis ; 4e article pas plus long que gros, tronqué obliquement au bout distal ; 5e un peu plus long que le 3e ; métatarse postérieur égalant la moitié du tibia, égal aux 4 suivants réunis ; crochets petits, à peine plus longs que le tiers de l'article, simples et égaux ; tarses sans spinules. Abdomen sublinéaire, de moitié plus long que le reste du corps. Taille 2·5 mm.

District Purneah : Katihar (C. Paiva) ; 4-viii ; 2 exemplaires.

Var. LINEOLA, ♀. D'un roux marron, mat et à peu près glabre ; antennes d'un jaune brunâtre, sauf le scape ; hanches et pattes jaunes ; dessus de l'abdomen et deux derniers articles tarsaux d'un brun noir, balanciers blanchâtres. Yeux séparés par une ligne rousse. Antennes et thorax comme chez le type. Ailes hyalines, à nervures pâles ; radius aboutissant bien au delà du milieu de l'aile ; cubitus de moitié plus long que le radius, formant avec lui une cellule également étroite, distant d'au moins sa moitié de la pointe alaire ; bifurcation de la discoïdale et celle de la posticale situées sous la transversale ; rameau inférieur de la discoïdale à peine plus rapproché de la pointe alaire que le cubitus ; nervure anale bifurquée. Fémurs et

tarses inermes ; tibias postérieurs ciliés en dehors, avec un peigne double, à peine plus courts que le tarse, doubles du métatarse ; celui-ci égal aux trois articles suivants réunis ; 4e de moitié plus long que gros, tronqué obliquement ; 5e égal au 3e, qui est double du 4e ; crochets simples, égaux, plus courts que la moitié de l'article ; dessous des articles 1-3 avec deux rangées de soies bulbeuses. Abdomen grêle, allongé, presque cylindrique, de moitié plus long que le reste du corps. Taille 2·5 mm.

Côte d'Orissa : Puri, en janvier.

3. *Bezzia facialis*, sp. nov.

(Pl. viii, fig. 11, aile.)

♂. Noir, mat et glabre ; antennes sauf l'article basal, brunâtres ; face, hanches et pattes d'un blanc brunâtre, metanotum d'un roux brunâtre, balanciers blanchâtres. Yeux très larges, la face et le front ne formant qu'une ligne longitudinale un peu élargie en bas ; yeux très distants au vertex ; bouche et palpes non proéminents. Article 2e des antennes obconique, plus long que le 3e ; 3-10 à peine plus longs que gros, 11e deux fois aussi long que gros, 12-14 trois à quatre fois aussi longs que gros, avec quelques soies dressées ; panache gris, très peu dense, n'atteignant que le milieu des antennes. Ailes hyalines (pl. viii, fig. 11), finement ponctuées, sans soies ; nervures très pâles ; radius dépassant le milieu de l'aile ; cubitus parallèle au radius et presque deux fois aussi long que lui ; bifurcation de la discoïdale située sous la transversale ; bifurcation de la posticale à peine en arrière de la transversale. Pattes inermes, sans longs poils ; tibias antérieurs aussi longs que le tarse, métatarse antérieur égal aux articles 2 et 3 réunis ; 4e article de moitié plus long que gros ; 5e un peu arquél, deux fois aussi long que le 4e ; crochets petits, égaux et simples. Taille 1·5 mm.

Calcutta, Jardin Zoologique, en juillet (N. Annandale).

4. *Bezzia lacteipennis*, sp. nov.

♀. Noir ; face, front et parfois la base des antennes d'un roux brun ; pattes d'un brunâtre clair, tarses blanchâtres, le 5e article noir ; balanciers blanchâtres, base de l'abdomen parfois brune. Yeux confluents ; bouche en bec. Articles antennaires 3-9 subglobuleux, 10-14 deux fois aussi longs que gros ; poils deux fois aussi longs que l'épaisseur des articles. Mesonotum mat, parfois cendré. Ailes blanches ; radius atteignant le milieu de l'aile ; cubitus aboutissant avant le quart distal de l'aile, trois fois aussi long que le radius, à peine plus rapproché de la pointe alaire que le rameau supérieur de la posticale ; bifurcation de la discoïdale située avant la transversale, bifurcation de la posticale située un peu après la transversale, surface ponctuée. Pattes grêles ; fémurs inermes, à peine plus gros que les tibias, qui sont à peine plus gros que les tarses ; tibias postérieurs avec un peigne double ; métatarse antérieur égal à la moitié du tibia ; aux pattes postérieures, les tibias sont faiblement ciliés et de moitié plus courts que les tarses, le métatarse est égal aux deux tiers du tibia, avec des soies bulbeuses sur son dessous, 3e article trois fois aussi long que gros, 4e article un peu plus long que gros ; 5e un peu plus long que le 3e, avec 4 paires de spinules à

toutes les pattes ; crochets tarsaux égaux, atteignant les deux tiers de la longueur de l'article, chacun avec une dent basale égale au tiers de sa longueur. Taille 2 mm

Calcutta, 5-viii.

Variété. ♀. Pattes rousses ; hanches, extrémité des fémurs antérieurs, les fémurs postérieurs en entier, base des tibias postérieurs et 5e article de tous les tarses d'un brun noir. Ailes hyalines. Taille 2·5 mm.

Orissa : Lake Chilka, Gopkuda Island.

5. *Bezzia nigricans*, sp. nov.

♀. Noir, mat et glabre ; balanciers d'un blanc de lait ; antennes, hanches et pattes d'un jaune brunâtre, articulations des pattes et dernier article tarsal noirs, premier article antennaire brun. Yeux confluents. Antennes aussi longues que la tête et le thorax réunis ; 2e article obconique, un peu plus long que gros ; les suivants globuleux ; les cinq derniers 2-3 fois aussi longs que gros, amincis à l'extrémité ; poils 2-3 fois aussi longs que l'épaisseur des articles. Ailes hyalines, glabres ; radius dépassant le milieu ; cubitus de moitié plus long que le radius, son extrémité est plus éloignée de la pointe alaire que le rameau inférieur de la discoïdale, mais plus rapprochée que le rameau supérieur de la posticale ; bifurcation de la discoïdale à peine en-deçà de la transversale, qui est perpendiculaire ; bifurcation de la posticale un peu au-delà de la transversale ; anale bifurquée ; toutes les nervures pâles et subhyalines ; cellule radiale également mince sur tout son parcours. Fémurs non grossis, sans spinules ; tibias antérieurs au moins deux fois aussi longs que le métatarse, plus longs que le tarse ; tibias postérieurs ciliés en dehors, plus courts que le tarse, d'un tiers plus longs que le métatarse, celui-ci égal aux quatre articles suivants réunis, 4e encore de moitié plus long que gros, 5e égal au 3e et au 4e réunis, avec deux rangées de 4—6 spinules sur le dessous ; crochets égaux, aussi longs que les deux tiers de l'article, avec une dent basale qui atteint le tiers de leur longueur et qui simule un crochet ; les deux premiers articles des tarses postérieurs munis, sur le dessous, de deux rangées de soies bulbeuses. Abdomen conique, un peu plus long que le reste du corps. Taille 1·8 mm.

Calcutta, 27-vii (C. A. Paiva).

6. *Bezzia armatipes*, sp. nov.

♀. Noir brun ; antennes, scutellum et balanciers bruns ; trochanters et fémurs sauf la moitié distale des fémurs postérieurs d'un testacé brunâtre ; tibias d'un brun noir, avec deux anneaux blancs, dont le proximal est plus petit ; tarses blancs. Bouche longue et pointue ; articles du flagellum globuleux ; les cinq derniers subcylindriques, un peu plus longs que gros, ensemble à peine plus longs que les huit précédents réunis. Thorax faiblement luisant et presque glabre. Ailes hyalines, glabres, à nervures pâles ; radius atteignant le milieu de l'aile ; cubitus distant de la pointe alaire d'un peu moins de sa longueur, assez rapproché de la costale, $2\frac{1}{2}$ fois aussi long que le radius ; discoïdale bifurquée sous la transversale, rameau

supérieur aboutissant à peine en dessous de la pointe alaire ; posticale bifurquée au delà de la transversale, son rameau supérieur un peu plus distant de la pointe alaire que le cubitus ; anale bifurquée, peu marquée. Pattes faiblement renflées, sauf les tarses qui sont très amincis ; fémurs antérieurs armés de trois spinules dans leur moitié distale ; tibias antérieurs à peigne simple, égalant la moitié de l'éperon ; métatarse de toutes les pattes égalant environ la moitié du tibia, à peine plus court que les trois articles suivants réunis ; 3e article deux fois aussi long que gros, un peu plus court que le 2e, et un peu plus long que le 4e, qui est tronqué obliquement à son extrémité distale ; 5e article un peu plus mince, à peine plus court que les deux précédents réunis ; crochets tarsaux simples, égaux, égalant le tiers de l'article ; toutes les pattes pubescentes, sans longs poils. Abdomen subglabre, mat, presque linéaire, déprimé, deux fois aussi long que le reste du corps. Taille 1·8 mm.

Côte d'Orissa : Puri, en janvier.

7. *Bezzia rufiventris*, sp. nov.

♀. D'un gris cendré et mat ; antennes, sauf les 5 derniers articles qui sont noirâtres, pattes et abdomen d'un roux brun ; hanches, tiers distal des fémurs, base des tibias, les tibias postérieurs en entier et les deux premiers segments abdominaux noirs ; 5e article tarsal assombri ; scutellum d'un brun clair ; balanciers blanchâtres. Tête un peu plus large que le thorax, trois fois aussi large que longue, étant vue d'en haut, beaucoup plus haute que longue étant vue de côté ; bouche en bec égal au tiers de la hauteur de la tête ; yeux glabres, grands, largement confluents au vertex, échancrés près des antennes ; palpes de 4 articles courts. Antennes de 14 articles ; scape gros ; 2e article un peu plus long que le 3e ; 3-9 subcylindriques, presque deux fois aussi longs que gros ; 10-11 deux à trois fois aussi longs que l'article 9e, tous à poils dressés, qui sont deux fois aussi longs que l'épaisseur des articles. Thorax convexe, moins élevé que le vertex, subglabre. Ailes hyalines, d'un tiers plus longues que l'abdomen ; surface finement ponctuée ; radius dépassant notablement le milieu de l'aile ; cubitus faiblement arqué, deux fois aussi long que le radius, son extrémité est distante de la pointe alaire du tiers de sa longueur ; discoïdale bifurquée un peu avant la transversale, rameau antérieur aboutissant à peine en dessous de la pointe alaire ; posticale bifurquée en arrière de la transversale ; anale bifurquée. Fémurs subcylindriques et subglabres, les antérieurs plus gros que les autres, deux fois aussi gros que les tibias, avec 6-8 petites spinules noires, dans leur moitié distale, sur le dessous ; tibias à poils dressés et peu abondants ; tarses un peu plus minces et un peu plus longs que les tibias ; métatarse égal aux articles 2 et 3 réunis ; 3e article de moitié plus long que gros ; 4e pas plus long que gros ; 5e plus long que le 3e et le 4e réunis, avec 5 paires de spinules noires, sur le dessous ; crochets simples, très longs et inégaux, le grand aussi long que l'article, l'autre d'un tiers plus court ; aux tarses postérieurs, les deux premiers articles ont, sur le dessous, des soies bulbeuses alignées ; tibias intermédiaires sans peigne. Abdomen allongé sublinéaire, déprimé. Taille 2·5 mm.

Calcutta, 10-viii.

5e Genre, CALYPTOPOGON, gen. nov.

Ce genre se reconnait à la conformation du thorax, qui est prolongé au-dessus de la tête en forme de cône pointu, et à la nervation alaire, qui ressemble à celle du genre *Bezzia*, sauf que la nervure anale faït défaut, que le cubitus touche presque le bord sur toute son étendue, et que le radius est indistinct.

Calyptopogon albitarsis, sp. nov

(Pl. viii, fig. 2, crochets des tarses postérieurs ; fig. 6 ♀.)

♀. Noir, brillant et glabre ; hanches, trochanters et base des fémurs bruns ; tarses blancs. Tête globuleuse ; yeux glabres, trois fois aussi larges que la face, un peu échancrés près des antennes, assez longuement distants au vertex ; bouche en bec oblique, égale au tiers de la hauteur de la tête ; palpes de 4 articles courts et subcylindriques. Antennes de 14 articles ; scape très gros, obconique, pas plus long que gros, les suivants cylindriques et très minces ; 2e article aussi long que le 3e et le 4e réunis ; 3-9 deux fois aussi longs que gros, à poils courts ; 10-14 très longs, trois fois aussi longs qu'un des articles précédents, à poils épars et aussi longs que le tiers de l'article. Thorax prolongé en avant jusqu' au-dessus du milieu du vertex, sous forme de cône pointu. Ailes étroites et très longues, dépassant l'abdomen de plus de leur moitié, un peu pointues à l'extrémité distale, hyalines, irrisées, couvertes de soies microscopiques, dressées et denses, nervures jaunes ; nervure auxiliaire indiquée par un vestige visible au microscope, et n'atteignant pas la transversale ; sous-costale grosse, très rapprochée de la costale, radius visible seulement au microscope, deux fois aussi long que la transversale ; cubitus continuant la direction de la partie proximale du radius, très rapproché du bord qu'il touche presque, non relié au radius, aboutissant un peu avant la pointe de l'aile et dépassé par la costale qui atteint la pointe alaire ; transversale longue, perpendiculaire, aboutissant un peu en arrière de la bifurcation de la discoïdale ; rameau antérieur de la discoïdale à peu près droit sauf à sa base, son extrémité est encore plus rapprochée de la pointe alaire que celle du cubitus ; rameau postérieur presque droit, son extrémité à peine plus près de l'antérieur que de la nervure posticale ; celle-ci se bifurque un peu avant la transversale, les deux rameaux presque droits. Balanciers ovoïdaux, tige longue. Fémurs et tibias beaucoup plus gros que les tarses, brillants, les fémurs un peu renflés au tiers distal, glabres dorsalement, avec des soies microscopiques sur le dessous, tibias avec des poils longs et épars, surtout les postérieurs ; extrémité de tous les tibias avec un peigne jaune, les postérieurs ont en outre 4 soies brunes deux fois aussi longues que le peigne ; métatarse antérieur aussi long que les 4 articles suivants réunis, 2e article égal aux 3e et 4e réunis, ceux-ci à peine plus longs que gros, le 4e densément pubescent dessous ; 5e un peu plus long que le 2e, avec 2 spinules noires et juxtaposées près de son extrémité, sur le dessous ; crochets tarsaux de toutes les pattes égaux, un peu plus courts que la moitié de l'article, avec une courte dent à leur base au côté externe (pl. viii, fig. 2) ; tarses postérieurs très longs et très grêles, métatarse deux fois aussi long que le tibia, sa partie ventrale avec des soies courtes, bulbeuses et formant une

seule rangée ; articles 2-5 avec quelques longs poils sur le dessus, qui sont 3 à 4 fois aussi longs que la grosseur de l'article ; les articles tarsaux 1-5 graduellement raccourcis ; le 5e encore 4 à 5 fois aussi long que gros, avec deux paires de spinules noires sur le dessous ; empodium nul. Abdomen grêle, d'égale largeur, de moitié plus long que le reste du corps. Taille 2 mm.

Calcutta, 11-viii (3 échantillons).

Il faut encore rapporter à ce genre l'insecte décrit par Wiedemann sous le nom de *Macropeza gibbosa*, Wied. (*Aussereurop. Zweiflügl. Insecten*, vol. i, p. 20, 1828), dans les termes suivants : " Noir ; pattes antérieures et intermédiaires jaunes avec l'extrémité noire ; pattes postérieures blanchâtres. *Partie antérieure du thorax amincie en pointe, recouvrant la tête.* Ailes hyalines. Pattes postérieures très allongées, finement velues. Taille 4·4 mm. Indes Orientales."

6e Genre, Macropeza, Meigen.

Macropeza javanensis, sp. nov.

Sous le nom de *Macropeza gibbosa*, Wied., de Meijere a décrit[1] un insecte de Semarang, qu'il pense être identique à celui des Indes Orientales, décrit par Wiedemann. Comme l'auteur ne dit rien de la forme du thorax, j'en conclue que le diptère de Semarang a le thorax conformé comme chez *Macropeza*, c'est à dire, comme chez tous les Ceratopogonines connues jusqu' 1903, et que par suite, il diffère de celui que Wiedemann a observé ; je le désigne du nom de *Macropeza javanensis*.

II. TANYPINÆ.

1er Genre, Isoplastus, Skuse.

Les ailes sont poilues, la 2e transversale aboutit au rameau supérieur de la posticale ; 4e article tarsal plus long que le 5e.

1.	Ailes hyalines, sans tache ; pattes blanchâtres	2.
	Ailes blanches, tachetées de noir ; pattes blanches, annelées de noir ..	5.
2.	Cubitus arqué, très rapproché du bord, presque deux fois aussi long que la partie distale du radius	3.
	Cubitus droit, éloigné du bord, de moitié plus long que la partie distale du radius	1. *I. annandalei*, sp. nov.
3.	Articles du flagellum de la femelle allongés	3. *I. macrocerus*, sp. nov.
	Articles du flagellum de la femelle globuleux, sauf le dernier	4.
4.	Verticilles des antennes environ deux fois aussi longs que la grosseur des articles ; les deux transversales sont distantes l'une de l'autre	2. *I. indicus*, sp. nov.

[1] *Tijdschr. voor Entomologie*, 1907, vol. 50, p. 216.

Verticilles des antennes très longs, 4-5 fois aussi longs que l'èpaisseur des articles ; les deux transversales se touchent .. 4. *I. setosicornis*, sp. nov.

5. Cubitus à peine plus distant de la pointe alaire que la discoïdale ; thorax noir, mesonotum cendré, avec 4 minces bandes noires ; ailes avec 4 taches noires outre les taches enfumées; tibias avec trois anneaux et l'extrémité noirs .. .. 6. *I. ornatipes*, sp. nov.

Cubitus au moins 4 fois plus distant de la pointe alaire que la discoïdale; tibias avec deux anneaux et l'extrémité noirs 6.

6. Ailes avec 5 taches noires outre les taches enfumées ; abdomen du mâle blanchâtre, thorax d'un brun roux .. .. 7. *I. pulchripes*, sp. nov.

Ailes avec 4 taches noires, sans taches enfumées bien distinctes, abdomen du mâle brun .. .. .. 5. *I. paivai*, sp. nov.

Ailes avec 3 taches noires outre les taches enfumées ; abdomen du mâle blanc, le pénultième et l'antépénultième segments noirs, thorax jaune, scutellum blanc .. 8. *I. variipes*, sp. nov.

1. *Isoplastus annandalei*, sp. nov.

(Pl. ix, fig. 6, peigne du tibia postérieur; fig. 7, article terminal du tarse antérieur; fig. 9 ♂.)

♂. Entièrement d'un jaune blanchâtre. Yeux glabres, très réniformes, leur partie basale trois fois aussi large que leur partie supérieure, distants au vertex. Palpes de 4 articles grêles et longs. Antennes de 13 articles ; 2 à 11 transversaux ; 12 un peu plus long que les articles 2 à 11 réunis ; 13^{e} court, aminci graduellement, 3 à 4 fois aussi long que gros ; plumet à poils dressés. Ailes hyalines, à surface ponctuée et parsemée de poils longs ; toutes les nervures avec des soies ; nervure auxiliaire dépassant un peu la transversale; cubitus droit, éloigné du bord, de moitié plus long que le radius, son extrémité très éloignée de la pointe alaire, aussi distante d'elle que du radius qui est simple, 2^{e} longitudinale nulle, transversale ordinaire oblique ; discoïdale aboutissant en-dessous de la pointe a aire ; rameau supérieur de la posticale oblitéré à sa base. Pattes avec des poils au maximum deux fois aussi longs que leur épaisseur ; tibias postérieurs avec un peigne composé de longues spinules jaunes, libres jusqu'à leur base et plus courtes que le grand éperon, qui n'est pas dentelé; les autres tibias sans peigne ; métatarse antérieur et postérieur aussi long que le tibia ; aux pattes antérieures, le 4^{e} article tarsal est double du 5^{e}, qui est 2 à 3 fois aussi long que gros ; sans empodium ni pulvilles. Abdomen deux fois aussi long

que le reste du corps, cylindrique, à 8 segments allongés, le 8e obconique ; pince sans lamelles ; articles basaux allongés, sans appendices au côte interne ; articles terminaux un peu plus courts que les basaux, faiblement arqués, minces et graduellement amincis en pointe. Taille 2·3 mm.

Calcutta, juillet 1907 (Annandale).

2. *Isoplastus indicus*, sp. nov.

♀ ♂. Roussâtre ; balanciers blancs ; pattes blanchâtres ; abdomen du mâle avec un anneau sur les segments 2 et 3, et les trois derniers segments en entier d'un brun noir ; pince blanche. Yeux très arqués, amincis au tiers apical, où ils sont médiocrement distants. Articles du flagellum globuleux chez la femelle, sauf le dernier, qui est allongé et égal aux deux précédents réunis ; verticilles pas plus de deux fois aussi longs que l'épaisseur des articles ; chez le mâle, les articles sont transversaux, sauf les deux derniers ; avant-dernier un peu plus long que les précédents réunis ; le dernier brun ; panache brunâtre. Pronotum non lobé. Ailes hyalines, à poils longs et appliqués, nervures pâles ; nervure auxiliaire dépassant notablement la transversale ; extrémité du radius non bifurquée, un peu plus près de la pointe alaire que l'extrémité du rameau inférieur de la posticale ; 2e nervure indistincte ; cubitus arqué, très rapproché du bord, presque deux fois aussi long que le radius, son extrémité non dépassée par la costale, un peu plus rapprochée de la pointe alaire que le rameau supérieur de la posticale ; discoïdale droite, aboutissant à la pointe alaire ; transversale ordinaire oblique, plus longue que 2e transversale : celle-ci perpendiculaire, située un peu en-deçà de la transversale ordinaire et atteignant la base arquée du rameau supérieur de la posticale ; anale simple. Pattes velues ; chez le mâle, les fémurs et les tibias des quatre pattes postérieures sont munis de poils très longs ; métatarse antérieur un peu plus court que le tibia, égal aux deux articles suivants réunis ; 4e article deux fois aussi long que le 5e, qui est 3 à 4 fois aussi long que gros, tous grêles et cylindriques, empodium filiforme et très petit, pulvilles nuls. Abdomen grêle chez le mâle, $2\frac{1}{2}$ fois aussi long que le reste du corps, segment anal plus large que les précédents ; pince grêle et allongée, article basal sans appendice, article terminal très mince, arqué, pointu et aussi long que le basal, lamelle nulle. Abdomen de la femelle pas plus long que le reste du corps, faiblement comprimé, ayant sa plus grande hauteur au milieu. Taille ♀ 2·5 mm., ♂ 1·8 mm.

Calcutta, en janvier et en juillet (N. Annandale) ; Katihar, District de Purneah, en juillet, 8 exemplaires (C. Paiva).

3. *Isoplastus macrocerus*, sp. nov.

♀. Roussâtre ; balanciers blancs ; tête, antennes et pattes (tarses ?) d'un blanc jaunâtre. Yeux très arqués, subitement amincis dans un peu plus du tiers supérieur, ces parties amincies sont linéaires et séparées l'une de l'autre par leur largeur. Antennes de 12 articles, le 2e un peu plus gros que les suivants, cylindrique ; 3-11 presque deux fois aussi longs que gros, un peu plus épais au milieu qu'aux deux

extrémités, avec un verticille quatre fois aussi long que leur épaisseur ; 12e article un peu épaissi, pointu au bout, pas deux fois aussi long que le 11e. Ailes faiblement teintées, densément poilues ; nervation comme chez *indicus*, sauf que les deux transversales se touchent et que l'extrémité du cubitus est à peine plus distante de la pointe alaire que la discoïdale. Pattes avec une pilosité un peu plus longue que leur épaisseur. Abdomen comprimé, aussi long que le reste du corps, ayant sa plus grande hauteur au milieu. Taille 1·8 mm.

Nepal : Chamaspur, en novembre.

4. *Isoplastus setosicornis*, sp. nov.

♀. D'un blanc jaunâtre, pattes plus claires, balanciers d'un blanc pur. Bouche aussi longue que la hauteur de la tête ; palpes longs ; yeux séparés seulement par une ligne au vertex et à la face, front largement transversal. Antennes de 12 articles ; le 2e article obconique, à peine plus long que gros ; 3-11 globuleux ; verticilles très longs, 4-5 fois aussi longs que l'épaisseur des articles ; 12e article subcylindrique, mince, égal aux deux précédents réunis, dépourvu de verticille comme d'ordinaire. Pronotum non lobé. Ailes presque hyalines, poilues, sans taches ; radius pas distinctement bifurqué à l'extrémité, cubitus très rapproché du bord auquel il est parallèle ; 2e nervure transversale touchant la 1e, atteignant la base arquée de la posticale. Pattes avec des poils deux à trois fois aussi longs que leur épaisseur ; tous les tarses étaient brisés. Abdomen un peu comprimé, guère plus long que le reste du corps. Taille 1·3 mm.

Bengal : Bettiah, Champaran, en mars.

5. *Isoplastus paivai*, sp. nov.

♂. D'un brun noir ; antennes et panache bruns ; scutellum d'un roux brun ; balanciers brunâtres ; pattes d'un blanc sâle, plus sombres sur les fémurs ; extrémité des fémurs, deux anneaux et extrémité des tibias, un anneau et l'extrémité des métatarses, extrémité des deux articles tarsaux suivants, et les deux derniers articles en entier, brun noir ; abdomen brun. Articles du flagellum un peu transversaux, sauf les deux derniers ; l'avant-dernier guère plus long que les précédents réunis. Pronotum non lobé. Mesonotum mat et subglabre. Ailes blanchâtres, également poilues sur toute leur surface, avec 4 taches noires très petites et presque ponctiformes, et des vestiges de taches enfumées ; les taches noires sont situées à l'extrémité du cubitus, à l'extrémité du radius, sur les deux transversales et sur la transversale qui relie la base de la sous-costale à la discoïdale ; radius bifurqué à l'extrémité, 2e longitudinale à peine visible ; cubitus droit, son extrémité non dépassée par la costale, éloignée de la pointe alaire presque autant que le rameau supérieur de la posticale ; discoïdale aboutissant à peine en dessous de la pointe de l'aile ; extrémité du rameau inférieur de la posticale à peine plus éloignée de la pointe alaire que le radius ; transversales obliques et se touchant, la 2e atteint la base arquée du rameau supérieur de la posticale. Tibias antérieurs de moitié plus longs que le métatarse, 4e article

tarsal un peu plus long que le 5e qui est 2-3 fois aussi long que gros ; tibia postérieur avec des cils guère plus longs que son épaisseur. Abdomen grêle, presque deux fois aussi long que le reste du corps, les deux derniers segments élargis. Taille 2 mm.

"Between Manihari and Manshahi, E. B. S. Ry., Bengal, on railway track," 4-viii-07 (C. Paiva).

6. *Isoplastus ornatipes*, sp. nov.

♀. Noir et mat ; antennes jaunâtres ; abdomen brun, balanciers et pattes blanches ; extrémité des fémurs, des tibias et des quatre premiers articles tarsaux, trois autres anneaux sur les tibias et un sur le milieu du métatarse, noirs. Article 2e des antennes deux fois aussi long que gros, les suivants globuleux, avec un verticille quatre fois aussi long que leur épaisseur, le dernier allongé, égal aux deux précédents réunis. Pronotum non lobé. Mesonotum très convexe, cendré, pubescent, avec 4 minces bandes noires. Ailes densément velues, blanches, avec des taches noires et brunes ; noires sont quatre petites taches situées sur la base du cubitus, sur l'extrémité du radius, de la 2e longitudinale et du cubitus ; les autres taches sont brunes, à reflet irrisé ; l'une occupe la cellule costale depuis la base alaire jusqu'a l'origine du cubitus ; l'autre forme une mince bande transversale en zigzac avant la pointe alaire ; une autre plus large et irrégulière, aboutit à l'extrémité du rameau inférieur de la posticale ; enfin des taches irrégulières sont situées entre la tige de la posticale et le bord inférieur ; extrémité du radius bifurquée, située avant l'extrémité du rameau inférieur de la posticale ; extrémité de la 2e longitudinale située plus près du radius que du cubitus ; celui-ci très rapproché du bord et aboutissant près de la pointe alaire ; discoïdale faiblement arquée, aboutissant à peine en dessous de la pointe alaire, dont elle est un peu plus rapprochée que le cubitus ; les deux transversales sont obliques et se touchent, la 2e aboutit à la base du rameau supérieur de la posticale. Tibias postérieurs et tous les fémurs ciliés sur le dessous ; métatarse des quatre pattes antérieures un peu plus court que le tibia ; article 4e plus long que le 5e, qui est plus mince et 2 à 3 fois aussi long que gros ; crochets tarsaux simples, avec des soies à leur base, empodium très petit, pulvilles nuls. Abdomen velu, comprimé, un peu plus long que le reste du corps. Taille 2 mm.

Côte d'Orissa : Puri, en janvier (N. Annandale).

7. *Isoplastus pulchripes*, sp. nov.

♀ ♂. D'un brun roux ; balanciers et pattes blancs ; extrémité des tibias et des métatarses, deux autres anneaux sur les tibias et un sur le milieu des métatarses, tiers distal des articles tarsaux suivants, noirs ; antennes blanches chez la femelle, avec l'article terminal assombri ; antennes et panache du mâle d'un blanc grisâtre, abdomen du mâle blanchâtre, velu de blanc comme le thorax. Articles du flagellum du mâle transversaux, sauf les deux derniers, l'avant-dernier plus long que les précédents réunis. Antennes de la femelle comme chez l'espèce précédente. Pronotum non lobé. Ailes blanches, très velues, avec 5 petites taches noires presque ponctiformes, et des taches enfumées, irrisées de violet et rarement bien délimitées ; les 5

taches noires sont situées à la base et à l'extrémité du radius, à l'extrémité du cubitus, sur la transversale ordinaire et sur la bifurcation de la posticale ; les taches enfumées se trouvent à l'extrémité de la discoïdale, des deux rameaux de la posticale et de l'anale ; en outre, trois entre la nervure anale et le bord, et quatre autres situées au tiers distal de l'aile, dont une sous l'extrémité du cubitus, une autre plus en deçà, entre le cubitus et la discoïdale, une sous la discoïdale et une sous le rameau supérieur de la posticale ; nervures blanchâtres, rameau inférieur de la posticale noir dans sa moitié distale ; nervure auxiliaire dépassant notablement la transversale ; extrémité du radius indistinctement bifurquée, plus près de celle du rameau supérieur que du rameau inférieur de la posticale ; 2e longitudinale non marquée ; cubitus arqué, touchant presque le bord à partir du radius, non dépassé par la costale, et 2-3 fois plus distant de la pointe alaire que la discoïdale, celle-ci aboutit un peu en-dessous de la pointe alaire ; transversale ordinaire oblique, plus longue que la 2e transversale, à laquelle elle aboutit, celle-ci sortant de la base arquée du rameau supérieur de la posticale. Métatarse de toutes les pattes égal au tibia, seulement un peu plus long que le 2e article ; 4e article plus long que le 5e ; tarse plus de deux fois aussi long que le tibia. Pince du mâle comme chez *indicus*. Taille ♀ 1·5 mm. ; ♂ 2 mm.

Calcutta, en février et en juillet, capturé à la lampe (5 exemplaires) ; côte d'Orissa : Puri, en janvier et en mars (19 exemplaires).

8. *Isoplastus variipes*, sp. nov.

♂. Blanc ; antennes brunâtres, panache gris ; thorax sauf le scutellum, d'un jaune roussâtre avec un vestige de trois bandes plus sombres ; le pénultième et l'antépénultième segment abdominal noirs ; deux anneaux et l'extrémité des tibias, l'extrémité des quatre premiers articles tarsaux, un anneau sur le milieu du métatarse, et le 5e article en entier, noirs ; fémurs antérieurs avec un anneau brun et très mince avant son extrémité ; pince d'un blanc sâle. Yeux largement séparés au vertex. Articles du flagellum transversaux, sauf les deux derniers ; l'avant-dernier un peu plus long que les précédents réunis. Pronotum non lobé. Ailes blanches, très poilues, avec trois petites taches noires et de nombreuses taches enfumées ; les taches noires sont : un petit trait transversal sur la base du cubitus et sur les deux transversales, une très petite tache à l'extrémité du radius, une autre à l'extrémité du cubitus ; les taches enfumées sont : une bande transversale depuis l'extrémité du radius jusqu'au rameau inférieur de la posticale, une grande tache transversale sous l'extrémité du cubitus, 5 autres plus petites et subarroudies, situées une à l'extrémité de la discoïdale et de chaque rameau de la posticale, et deux entre le pétiole de la posticale et le bord inférieur de l'aile ; radius bifurqué très distinctement à l'extrémité ; 2e longitudinale deux à trois fois plus près du radius que du cubitus à son extrémité ; cubitus peu distant du bord, un peu plus près de la pointe alaire que le rameau supérieur de la posticale ; discoïdale aboutissant à peine en dessous de la pointe ; 2e transversale située à peine en deçà de la 1re, atteignant la base arquée du rameau supérieur de la posticale. Tibias antérieurs guère plus longs que le métatarse ; 5e article tarsal un peu plus court que le 4e,

presque deux fois aussi long que gros ; fémurs et tibias postérieurs brièvement ciliés, les cils pas deux fois aussi longs que l'épaisseur des tibias. Abdomen grêle, deux fois aussi long que le reste du corps ; pénultième segment élargi. Taille 2·5 mm.

Upper Burma : Maudalay, en mars (N. Annandale).

2e Genre, Procladius, Skuse.

Ailes non poilues ; transversale atteignant le pétiole de la posticale ; 4e article de tous les tarses tronqué obliquement à l'extrémité distale et plus court que le 5e.

1. Ailes enfumées ou avec des taches enfumées	2.
Ailes subhyalines et sans tache ; dessus du thorax avec 9 petites taches noires ..	6. *P. novempunctatus*, sp. nov.
2. Pronotum divisé, par une incision triangulaire, en deux lobes ; mesonotum jaunâtre, avec 8 taches noires	1. *P. ornatissimus*, sp. nov.
Pronotum non bilobé ; mesonotum non avec 8 taches	3.
3. Ailes enfumées, sauf le tiers distal qui est hyalin	4.
Ailes subhyalines, avec une tache presque carrée sur la transversale ordinaire et une bande transversale à l'extrémité du radius	5.
4. Les 2 transversales se touchent ; corps d'un noir brillant	3. *paivai*, sp. nov.
Les 2 transversales sont distantes de toute leur longueur ; thorax d'un jaune roussâtre, tacheté de noir	2. *P. fumipennis*, sp. nov.
5. Les 2 transversales sont distantes de toute leur longueur	4. *P. fuscosignatus*, sp. nov.
Les 2 transversales se touchent ..	5. *P. atratus*, sp. nov.

1. *Procladius ornatissimus*, sp. nov.

♂. Blanc jaunâtre ; tête, pronotum, balanciers et trois premiers articles tarsaux blancs ; mesonotum avec 8 taches d'un noir brillant, dont deux en avant, séparées par une ligne longitudinale, deux autres plus grandes, allongées, situées sur les côtés, très distantes l'une de l'autre et s'étendant depuis la tache antérieure jusqu'à l'aile ; entre elles, de chaque côté de la ligne médiane, une petite tache ovalaire ; deux taches allongées atteignent le bord postérieur ; metanotum, sauf deux petites taches, extrémité des fémurs et des tibias, base des tibias intermédiaires, deux derniers articles tarsaux, ligne transversale sur les segments abdominaux et pince d'un noir brillant. Yeux très amincis au tiers supérieur, où ils sont distants de plus de la

largeur de la partie amincie ; antennes et panache jaunes, extrémité du panache d'un brun noir ; avant-dernier article deux fois aussi long que les précédents réunis. Pronotum divisé au milieu, par une incision triangulaire, en deux lobes. Ailes hyalines, non poilues, avec deux bandes transversales et étroites, et une tache circulaire, qui sont enfumées et irrisées ; l'une des bandes s'étend de l'extrémité du radius au rameau supérieur de la posticale, l'autre de la base du cubitus, par les deux transversales, jusqu'à la bifurcation de la posticale ; la tache est située entre le milieu de la nervure anale et le bord inférieur de l'aile ; en outre les deux rameaux de la posticale et l'extrémité de la discoïdale sont faiblement bordés de brunâtre ; nervures jaunes, sauf dans les parties enfumées, où elles sont noires ; une transversale relie la base du radius à celle de la costale : radius bifurqué à l'extrémité, son rameau antérieur presque ponctiforme, à peine plus distant de la pointe alaire que le rameau supérieur de la posticale ; extrémité de la 2e longitudinale plus proche du radius que du cubitus ; celui-ci presque droit, aussi rapproché de la pointe alaire que la discoïdale, dépassé par la costale ; transversale ordinaire très oblique, située un peu au delà de la 2e transversale qui est perpendiculaire ; partie distale du pétiole de la posticale un peu plus longue que la 2e transversale. Fémurs et tibias intermédiaires et postérieurs ciliés, les antérieurs pubescents ; tibias antérieurs un peu plus longs que le métatarse, 4e article tarsal un peu plus long que gros, tronqué obliquement à l'extrémité ; 5e article trois fois aussi long que gros ; empodium très court. Abdomen grêle, plus de deux fois aussi long que le reste du corps. Taille 4 mm.

U. Burma : Mandalay, en mars (N. Annandale) ; N. Bengal : Purneah, en juillet (C. Paiva).

2. *Procladius fumipennis*, sp. nov.

♀. D'un jaune roussâtre ; mesonotum avec une bande médiane et brune au tiers postérieur, et de chaque côté, une large bande brune interrompue au milieu ; metanotum et abdomen noirs, balanciers d'un brun noir avec l'extrémité blanchâtre, les 4 fémurs postérieurs bruns sauf les deux bouts, tibias antérieurs sauf un large anneau médian, un large anneau près de la base des 4 autres tibias, 4 derniers articles des tarses antérieurs, dernier article des autres tarses, d'un brun noir, métatarse antérieur blanchâtre ; abdomen parfois tacheté de roux. Yeux à peine amincis supérieurement, où ils sont distants de leur plus grande largeur. Articles du flagellum globuleux et serrés, le dernier lancéolé et aussi long que les trois précédents réunis ; verticilles guère plus longs que la grosseur des articles. Palpes longs, le 4e article aminci. Pronotum non lobé. Ailes enfumées et irrisées, sauf au tiers distal qui est hyalin, la partie située entre la costale et la discoïdale est plus fortement enfumée, nervures noirâtres sauf dans le tiers hyalin, où elles sont jaunes ; transversale ordinaire presque perpendiculaire, séparée de toute sa longueur de la 2e transversale, qui est perpendiculaire et située en deçà ; radius bifurqué à l'extrémité ; 2e longitudinale à peine plus rapprochée du radius que du cubitus ; celui-ci droit, à peine plus distant de la pointe alaire que la discoïdale, dépassé notablement par la costale ; partie distale du pétiole égale à la moitié du rameau inférieur ou un peu plus longue que la transversale ; surface non

poilue. Pattes pubescentes ; tibias antérieurs de moitié plus longs que le métatarse, 4e article tarsal transversal, tronqué obliquement à l'extrémité. 5e article 2-3 fois aussi long que gros. Abdomen comprimé, aussi long que le reste du corps. Taille 2·5 mm.

Calcutta, en mars et en juin (N. Annandale).

Une variété a l'abdomen largement jaune sur les côtés, les pattes d'un jaune brunâtre, avec les tibias et tarses antérieurs d'un brun noir, les autres tibias assombris dans leur moitié proximale. Taille ♀ 2·5 mm.

Côte d'Orissa : Puri, en mars (C. Paiva).

3. *Procladius paivai*, sp. nov.

♀. D'un noir brillant ; antennes et face jaunes ; fémurs noirs, les 4 postérieurs avec un anneau jaune avant l'extrémité, tibias noirs avec un large anneau jaune au-dessus de leur milieu, métatarse antérieur blanc, les 4 articles suivants noirs, tarses des quatre pattes postérieures blancs, dernier article noir, balanciers noirâtres; transversale ordinaire très oblique, touchant la 2e transversale ; bifurcation de la posticale située bien en arrière de la transversale ordinaire. Taille 2 mm. Pour tout le reste, semblable à l'espèce précédente.

Côte d'Orissa : Puri, en mars (C. Paiva).

4. *Procladius fuscosignatus*, sp. nov.

(Pl. xi, fig. 6, aile.)

♀ ♂. Brun noir ; tête, antennes, mesonotum, scutellum et pattes roux brunâtre ; moitié proximale des 4 métatarses antérieurs, tout le métatarse postérieur et un anneau près de l'extrémité des tibias postérieurs blanchâtres. Yeux très amincis supérieurement, où ils sont distants de moins de leur plus grande largeur ; bouche petite ; palpes de 4 articles courts. Antennes de la femelle de 15 articles ; 2e article presque deux fois aussi long que gros ; 3-14 globuleux ; 15e allongé, égal aux 13e et 14e réunis. Panache du mâle ferrugineux, blanchâtre à l'extrémité, brun avant l'extrémité. Pronotum non lobé. Thorax lisse, brillant, glabre, très convexe, non prolongé au-dessus de la tête, avec 4 larges bandes noires et deux grandes taches devant le scutellum ; les deux bandes internes occupent la moitié antérieure et sont séparées par une ligne, les deux externes sont raccourcies en avant. Ailes hyalines (pl. xi, fig. 6), avec une ponctuation formée par des soies microscopiques ; une bande transversale brune part de l'extrémité du radius et atteint presque le rameau supérieur de la posticale ; une grande tache carrée, d'un brun sombre, entoure la transversale ordinaire et la base du cubitus, et est reliée à l'extrémité inférieure de la bande, par un trait brunâtre qui longe le bord inférieur de la discoïdale ; un autre trait brunâtre occupe la cellule comprise entre la costale et la sous-costale et atteint la bande transversale ; la posticale est aussi faiblement bordée de brun ; auxiliaire atteignant l'extrémité du radius, qui est brièvement bifurquée ; 2e longitudinale pâle, son extrémité à peine plus près du radius que du cubitus ; celui-ci droit, aboutissant assez près de la pointe alaire et notablement dépassé par la costale ; discoïdale pâle, son extrémité

aussi rapprochée de la pointe alaire que le cubitus ; partie distale du pétiole de la posticale égalant la moitié du rameau postérieur, transversale ordinaire oblique ; 2e transversale perpendiculaire, à peine plus longue que la transversale ordinaire et distante d'elle de toute sa longueur ; les deux autres nervures simples. Pattes sans longs poils ; métatarse égal aux deux tiers du tibia ; 4e article plus court que le 5e, pas plus long que gros, tronqué obliquement et prolongé ventralement jusqu'au 2e tiers du 5e, qui est trois fois aussi long que gros ; éperons 1, 2, 2, larges et dentelés dans leur moitié basale ; tibias postérieurs avec un peigne, les 4 autres sans peigne ; crochets velus à la base ; empodium très petit, plus court que la moitié des crochets, pulvilles nuls. Abdomen de la femelle comprimé, aussi long que le reste du corps, lamelles blanches et petites, abdomen du mâle de moitié plus long que le reste du corps ; pince grosse et courte, 2e article plus court que l'article basal, graduellement aminci, pubescent dans sa moitié basale, puis subitement courbé presque à angle droit et glabre. Taille 2 mm.

Calcutta, Jardin Zoologique, en juillet (N. Annandale) ; Sylhet, Assam, en juillet (Major Hall) ; Purneah, Bengale septentrional (C. Paiva).

Var. ATERRIMUS, var. nov., ♀. Noir brillant ; face et antennes brunes ; une arête longitudinale, médiane et percurrente sur le mesonotum et les pattes antérieures d'un brunâtre clair ; métatarse antérieur blanc, les 4 articles suivants et les fémurs des 4 pattes postérieures d'un brun noir, les 4 tibias postérieurs d'un brun noir avec un large anneau jaune avant l'extrémité ; tarses des 4 pattes postérieures blanchâtres, sauf le 5e article qui est brun noir ; balanciers blancs. Taille ♀ 2 mm.

Côte d'Orissa : Puri, en mars (C. Paiva).

Var. FLAVIDUS, var. nov., ♀ Tête, thorax, hanches et pattes jaunes ; extrémité des fémurs, un large anneau près de la base des tibias, extrémité des tibias, 4 derniers articles des tarses antérieurs et intermédiaires, dernier article des tarses postérieurs d'un brun noir ; mesonotum avec un vestige de trois bandes longitudinales. Ailes brunes à partir de la base jusqu'à la bande transversale, depuis le bord antérieur jusqu'à la discoïdale. Tout le reste comme chez le type.

Bengale, entre Bolpore et Rampore, 6 exemplaires capturés à la lampe, dans un carrosse.

5. *Procladius atratus*, sp. nov.

♀. D'un noir brillant ; pattes d'un brun noir ; un large anneau avant l'extrémité des tibias, métatarse antérieur, 4 premiers articles des tarses intermédiaires et postérieurs blancs. Ailes comme chez le type, sauf que la 2e transversale aboutit à la transversale ordinaire et qu'une teinte d'un brun clair relie la posticale au bord postérieur depuis la base de l'aile jusqu'à la bande transversale. Pour tout le reste, semblable à *fuscosignatus*. Taille 2 mm.

Sylhet, Assam (Major Hall).

6. *Procladius novempunctatus*, sp. nov.

♂. Roux ou brunâtre ; occiput et thorax blanchâtres ; dernier article antennaire sombre ; mesonotum avec trois bandes confluentes d'abord jaunes, puis d'un roux

marron, à la fin d'un brun noir, la médiane percurrente, les externes occupant la moitié postérieure ; scutellum et metanotum d'un jaune brunâtre ; dessus du thorax avec 9 points noirs, à savoir : 1 à l'extrémité de chacune des bandes externes, et une au côté externe de ces mêmes bandes ; 1 contre l'écaillette, à l'angle postérieur du mesonotum ; 1 de chaque côté du scutellum ; 1 à l'extrémité du metanotum ; base du metanotum avec une bande transversale noire et interrompue au milieu ; balanciers d'un roux clair ; pattes jaunâtres, les 3 ou 4 derniers articles tarsaux et l'extrémité des tibias antérieurs assombris ; une tache transversale noire sur les tergites 3, 4 et 6 ; pince d'un roux brun. Yeux subitement très amincis supérieurement, où ils sont distants de moins de leur plus grande largeur ; palpes de 4 articles très courts. Article terminal des antennes 3-4 fois aussi long que gros ; plumet brun ou fauve. Thorax conformé comme chez l'espèce précédente. Ailes presque hyalines, sans tache ; nervation comme chez le précédent, sauf que le rameau supérieur de la posticale est à peine arqué à sa base ; surface à soies denses et microscopiques ; transversale ordinaire noire, bordée de brun ; les autres nervures jaunâtres. Pattes conformées comme chez l'espèce précédente, sauf que les tibias et les fémurs des 4 pattes postérieures portent des poils dressés aussi longs que leur épaisseur. Abdomen grêle, plus mince au milieu, à poils dressés assez longs ; pince grosse ; article basal un peu arqué ; article terminal mince, long et faiblement arqué. Taille 4 mm.

Calcutta, en mai (N. Annandale) ; Alipore : Jardin Zoologique, en juillet ; Bengale : Rajmahal, en juillet, et entre Bolpore et Rampore, capturé la nuit à la lampe, dans un carrosse ; Bettiah, Champaran, Bengale, en mars ; Mandalay, U. Burma.

3e Genre, Tanypus, Meigen.

1. Pronotum découpé au milieu, par une incision aiguë, en deux lobes triangulaires et proéminents ; ailes tachetées	1. *T. bilobatus*, sp. nov.
Pronotum non lobé	2.
2. Ailes sans taches ni bandes	6. *T. microcerus*, sp. nov.
Ailes tachetées ou avec une bande transversale	3.
3. Ailes blanches, avec de nombreuses taches violacées et irrisées ; articles tarsaux noirs à leur extrémité distale	4.
Ailes avec une bande transversale enfumée, parfois encore avec deux taches ; articles tarsaux jaunâtres ou blanchâtres en entier	5.
4. Ailes avec des poils longs et appliqués, taches plus ou moins confluentes	3. *T. violaceipennis*, sp. nov.
Ailes densément ponctuées sauf au tiers apical qui est poilu ; taches distantes les unes des autres	4. *T. photophilus*, sp. nov.

5. Ailes subhyalines, avec une bande transversale et deux taches enfumées, poilues seulement sur les parties enfumées ; mesonotum avec deux lignes blanches .. .. 5. *T. albolineatus*, sp. nov.

Ailes blanches avec une large bande transversale brune, sans taches ; mesonotum sans bandes .. .. .. 2. *T. noctivagus*, sp. nov.

1. *Tanypus bilobatus*, sp. nov.

♂ ♀. Le mâle est d'un brun noir ; face et scape jaunâtres ; flagellum et panache d'un brun noir ; occiput, pronotum et mesonotum d'un blanc jaunâtre, ce dernier avec trois bandes d'un roux jaune, comme chez la femelle, avec une verrue ellipsoïdale sur le milieu de la médiane ; balanciers d'un brun noir ; pattes d'un blanc sâle, extrémité des fémurs et, aux fémurs antérieurs, un mince anneau au-dessus du milieu, extrémité des tibias et des quatre premiers articles tarsaux, et 5e article tarsal en entier, noirs. Antennes de 15 articles ; les articles 3-13 transversaux, le 14e environ deux fois aussi long que les 12 précédents réunis. Ailes comme chez la femelle, sauf que leur surface est finement pointillée, l'extrémité seulement est poilue. Tibias postérieurs brièvement ciliés, les cils pas deux fois aussi longs que la grosseur des tibias. Abdomen deux fois aussi long que le reste du corps, grêle, mince, les deux derniers segments élargis, jaunâtres, avec deux lignes noires longitudinales et parallèles ; pince noire, l'article terminal très mince et pointu. Taille 4-6 mm. Pour le reste, semblable à la femelle.

♀. Jaune brunâtre ; antennes et pattes jaunes ; extrémité des fémurs et des tibias, et articulations des tarses assombries ; mesonotum avec trois larges bandes brunes et confluentes, à reflet cendré en arrière, la médiane percurrente, divisée par une ligne longitudinale qui s'élargit au milieu en formant une petite proéminence ellipsoïdale, les externes occupant les deux tiers postérieurs, tronquées en avant ; scutellum cendré ; metanotum d'un brun brillant ; balanciers bruns à tige blanche ; côtés des tergites et bord postérieur des sternites assombris ; parfois corps d'un brun noir, mesonotum et scutellum à reflet cendré, sans trace de bandes, pattes rousses. Yeux glabres, sinueux, très minces vers le haut, où ils sont distants l'un de l'autre de moins de leur plus grande largeur. Palpes de 4 articles assez longs. Antennes de 15 articles ; 2e article aussi long que gros, peu distinctement séparé du 3e, qui est un peu transversal, comme les suivants ; les médians aussi longs que gros ; 12-14 un peu plus longs que gros ; 15e égal aux 3 précédents réunis, tiers apical graduellement aminci en stylet. Pronotum divisé par une incision aiguë, en deux lobes proéminents et surplombant la tête. Thorax subglabre. En arrière de la proéminence ellipsoïdale du mesonotum se trouve un espace elliptique plus grand, traversé par une ligne longitudinale et enfoncée. Ailes blanches, à poils longs et appliqués ; surface située entre le cubitus et la partie distale de la discoïdale avec quatre taches enfumées, irrisées et également espacées ; deux taches semblables se trouvent entre la moitié distale du rameau supérieur de la posticale et la discoïdale ; une autre sur le tiers

distal du rameau inférieur; une très petite entre l'extrémité de ce rameau et le rameau supérieur; enfin 8-10 taches petites, rapprochées, parfois confluentes, situées entre la nervure anale et une petite nervure oblique qui traverse le lobe alaire, celui-ci obtus et arrondi; radius faiblement marqué, bifurqué à l'extrémité; 2e longitudinale aussi bien marquée que le cubitus, son extrémité également distante du radius et du cubitus; celui-ci à peu près droit, aboutissant assez près de la pointe alaire et dépassée notablement par la costale; discoïdale pâle, droite, son extrémité est aussi distante de la pointe alaire que le cubitus; la base de la costale est réunie à la sous-costale par une transversale; la transversale ordinaire est oblique, plus longue que la partie distale du pétiole de la posticale, un peu plus courte que la 2e transversale et distante d'elle de toute sa longueur, toutes deux sont noires et bordées de noir; extrémité du rameau supérieur de la posticale deux fois plus près de la discoïdale que du rameau inférieur; deux nervures simples. Pattes à poils plus longs que leur épaisseur; éperons 1, 2, 2; métatarse postérieur égal au tibia, articles 1-5 graduellement raccourcis, 4e encore 6-8 fois aussi long que gros, presque deux fois aussi long que le 5e. Abdomen un peu plus long que le reste du corps, comprimé, également large et poilu. Taille 3·5 mm.

Sylhet, Assam, en février (Major Hall); Calcutta, en mai, juin, juillet et novembre (N. Annandale); Rajshahi, E. Bengal, en février.

2. *Tanypus noctivagus*, sp. nov.

♀. D'un roux carné; balanciers d'un blanc de lait; antennes et pattes jaunâtres. Corps à peu près glabre. Yeux largement séparés au vertex. Article 2e des antennes deux fois aussi long que gros, les suivants globuleux, le dernier ovoïdal et grossi. Pronotum non lobé. Ailes velues, blanches, avec une large bande brune, transversale, graduellement amincie inférieurement, s'étendant depuis un peu en deçà de l'extrémité du radius jusqu'à celle du cubitus et aboutissant au bord postérieur sous le rameau inférieur de la posticale; les deux transversales et la base du cubitus sont noires, les autres nervures sont blanchâtres sauf les parties qui traversent la bande brune; radius bifurqué à l'extrémité; extrémité de la 2e longitudinale un peu plus distante de la pointe alaire que le rameau supérieur de la posticale; cubitus arqué, dépassé notablement par la costale; partie distale du pétiole de la posticale égalant presque le rameau inférieur; transversale ordinaire un peu oblique, aboutissant à la 2e transversale, qui est plus petite et perpendiculaire. Tibias antérieurs de moitié plus longs que le métatarse, celui-ci égal aux trois articles suivants réunis; tous les tibias sont plus courts que les tarses. Abdomen pas plus long que le thorax, ovoïdal et comprimé. Taille 2·3 mm.

Capturé le 9 octobre, la nuit, sur le bateau, au canal de Suez (N Annandale).

3. *Tanypus violaceipennis*, sp. nov.

♀. Brun; mesonotum jaune, avec 3 bandes longitudinales brunes, dont la médiane est raccourcie en arrière, et les latérales raccourcies en avant; antennes jaunes;

pattes blanchâtres, extrémité de tous les articles tarsaux noire ; fémurs bruns, tiers distal blanchâtre, avec un étroit anneau brun. Palpes de 4 articles courts. Yeux glabres, sinueux, amincis supérieurement, où ils sont distants de moins de leur plus grande largeur. Articles du flagellum subglobuleux, sauf le dernier. Pronotum non lobé. Ailes à poils longs et appliqués, à surface violacée avec des taches blanches et nombreuses ; transversale ordinaire noire, les autres nervures jaunes ; radius bifurqué ; 2e longitudinale grosse, son extrémité à peine plus près du radius que du cubitus ; celui-ci notablement dépassé par la costale ; extrémité du rameau supérieur de la posticale de moitié plus près de la discoïdale que du rameau inférieur ; transversale ordinaire oblique, touchant presque la 2e transversale, qui est perpendiculaire et un peu plus courte que la partie distale du pétiole de la posticale. Fémurs et tibias à poils aussi longs que leur épaisseur, tarses pubescents ; métatarse antérieur à peine plus court que le tibia, 4e article un peu plus long que le 5e, quatre fois aussi long que gros ; crochets simples, empodium très petit, pulvilles nuls. Abdomen glabre, comprimé, un peu plus long que le reste du corps, ayant sa plus grande hauteur au milieu. Taille 2 mm.

Calcutta, en février (N. Annandale).

4. *Tanypus photophilus*, sp. nov.

♂. Tête et thorax roussâtres ; balanciers d'un brun noir, pattes blanchâtres ; un anneau avant l'extrémité des fémurs, l'extrémité des tibias et des 4 premiers articles tarsaux, et le 5e article en entier noirs ; trois larges bandes du mesonotum rousses, les latérales plus sombres que la médiane, raccourcies en avant, la médiane raccourcie en arrière ; abdomen d'un brun noir, plus clair sur les côtés. Yeux sinueux, amincis supérieurement où ils sont distants l'un de l'autre. Articles du flagellum transversaux, sauf les 2 derniers, l'avant-dernier de moitié plus long que les précédents réunis ; panache brunâtre. Ailes blanches, avec des taches enfumées, irrisées et distantes les unes des autres ; les 4 grandes taches situées entre le cubitus et la discoïdale, sont plus sombres que les autres ; surface densément pointillée, tiers distal avec de longs poils, nervures avec des poils semblables ; nervure auxiliaire dépassant de beaucoup la transversale ; radius bifurqué, plus rapproché de la pointe alaire que le rameau inférieur de la posticale ; extrémité de la 2e longitudinale un peu plus rapprochée du radius que du cubitus ; celui-ci arqué, dépassé notablement par la costale qui aboutit presque à la pointe ; discoïdale arquée, un peu plus rapprochée de la pointe alaire que le cubitus ; les deux transversales sont obliques et se touchent, partie distale du pétiole de la posticale plus longue qu'une des transversales ; trois autres nervures incomplètes. Pattes à poils peu longs ; métatarse antérieur un peu plus court que le tibia, plus long que les articles 2 et 3 réunis, 4e un peu plus long que le 5e, tous deux cylindriques, le 5e trois à quatre fois aussi long que gros. Abdomen grêle, deux fois aussi long que le reste du corps partie ventrale avec de longs poils gris ; pince d'un brun noir ; article basal gros, le terminal blanc, glabre, arqué, pointu, atteignant la moitié de la longueur et le quart de l'épaisseur de l'article basal. Taille 3 mm.

Calcutta, en janvier ; trois exemplaires capturés à la lampe (N. Annandale).

5. *Tanypus albolineatus*, sp. nov.

♂. D'un roux brun ; mince bord occipital, une ligne longitudinale, bifurquée en dehors vers son milieu et située de chaque côté de la moitié antérieure du mesonotum, balanciers et mince bord postérieur des segments abdominaux, blancs ; panache et antennes d'un brun noir ; pattes d'un blanc brunâtre, tarses plus clairs. Yeux amincis supérieurement dans moins de leur tiers, distants de la largeur de la partie amincie. Avant-dernier article antennaire presque deux fois aussi long que les précédents réunis. Pronotum non lobé. Ailes subhyalines, une bande et deux taches enfumées et irrisées, poilues seulement sur les taches enfumées ; la bande est transversale, percurrente et a comme limites la bifurcation de la posticale et l'extrémité du rameau supérieur, sauf que l'espace compris entre les deux rameaux est hyalin en majeure partie ; une petite tache couvre les deux transversales ; une autre, grande et circulaire, s'étend depuis la 2e transversale jusqu'au bord postérieur de l'aile ; nervure auxiliaire dépassant un peu la transversale ; radius bifurqué à l'extrémité, rameau supérieur presque ponctiforme, situé un peu en deçà de l'extrémité du rameau inférieur de la posticale ; 2e longitudinale atteignant le bord à peine en arrière du rameau supérieur de la posticale, plus près du radius que du cubitus ; celui-ci arqué, presque aussi rapproché de la pointe alaire que la discoïdale, dépassé notablement par la costale ; transversale ordinaire oblique, situé à peine en deçà de la 2e transversale, qui est perpendiculaire ; partie distale du pétiole de la posticale aussi long que le rameau inférieur. Tibias antérieurs un peu plus longs que le métatarse ; 5e article tarsal plus court que le 4e, 2-3 fois aussi long que gros. Abdomen grêle, subcylindrique, presque deux fois aussi long que le reste du corps. Taille 3 mm.

U. Burma : Mandalay, en mars (N. Annandale).

6. *Tanypus microcerus*, sp. nov.

♀. Blanchâtre ; thorax roussâtre, mesonotum blanchâtre avec trois larges bandes roussâtres et confluentes, dont les latérales sont raccourcies en avant. Yeux amincis sur un très petit espace, distants de deux fois cette partie amincie. Articles du flagellum serrés, globuleux, le dernier conique et égal aux deux précédents réunis, verticilles pas deux fois aussi longs que la grosseur des articles. Ailes faiblement jaunâtres, poilues dans leur moitié distale, nervures jaunes, transversale ordinaire bordée de brun noir ; nervation du précédent, sauf que la partie distale du pétiole de la posticale est un peu plus courte que le rameau inférieur, que l'extrémité du radius est située un peu au delà de l'extrémité du rameau inférieur de la posticale, et que les deux transversales se touchent. Pattes brièvement velues ; tibias postérieurs avec un peigne, d'un tiers plus long que le métatarse ; 4e article tarsal un peu plus long que le 5e, cylindrique ; 5e trois fois aussi long que gros ; empodium égal à la moitié de la longueur des crochets, pulvilles nuls. Abdomen aussi long que le reste du corps. Taille 1·8 mm.

Côte d'Orissa : Puri, en mars (C. Paiva).

III. CHIRONOMINÆ.

1^er^ Genre, CHIRONOMUS, Meigen.

Les quatre tibias postérieurs terminés par un anneau interrompu, noir et dentelé au bord distal ; métatarse antérieur plus long que le tibia ; ailes glabres.

1. Ailes sans tache ni bande .. .. 2.
   Ailes avec des taches ou avec des bandes .. 6.
2. Pulvilles à peu près aussi longs que l'empodium ; pattes du mâle sans longs poils .. 3.
   Pulvilles beaucoup plus courts que l'empodium (sous-genre *Prochironomus*). 4.
3. Lamelle supérieure de la pince non prolongée en un appendice linéaire .. 1. *C. camptogaster*, sp. nov.
   Lamelle supérieure de la pince prolongée en un long appendice linéaire .. .. 2. *C. longivalvis*, sp. nov.
4. Bifurcation de la posticale située notablement en arrière de la transversale ; abdomen d'un blanc pur, tiers postérieur noir 4. *C.* (*P.*) *prussicus*, sp. nov.
   Bifurcation de la posticale située sous la transversale ou à peine en arrière ; abdomen autrement coloré .. .. .. 5.
5. D'un blanc pur, les 5 premiers segments abdominaux avec deux taches en forme de U, les 3 derniers segments d'un brun noir .. .. 5. *C.* (*P.*) *pictiventris*, sp. nov.
   Brun, pattes d'un jaune brunâtre .. 6. *C.* (*P.*) *annandalei*, sp. nov.
   Noir brillant, pattes en partie et pince blanches .. .. .. 7. *C.* (*P.*) *albiforceps*, sp. nov.
6. Pulvilles à peu près aussi longs que l'empodium ; ailes blanches avec 4 taches enfumées, transversale noire, scutellum blanc avec 2 taches noires .. .. 3. *C. bipunctatus*, sp. nov.
   Pulvilles beaucoup plus courts que l'empodium (sous-genre *Prochironomus*) .. 7.
7. Ailes enfumées avec 4 taches hyalines ; pattes noires, tarses blancs en partie .. 8. *C.* (*P.*) *atripes*, sp. nov.
   Ailes hyalines ou blanches, avec des taches ou bandes sombres .. .. 8.
8. Ailes blanches, avec des taches enfumées ou noires .. .. .. 9.
   Ailes blanches ou hyalines, avec une ou plusieurs bandes .. .. 15.

9. Taches des ailes noires, circulaires et bien délimitées .. .. .. 10.
Taches enfumées, peu nettement délimitées .. 12.
10. Bifurcation de la posticale située bien en arrière de la transversale ; fémurs antérieurs renflés dans leur tiers distal .. 10. *C.* (*P.*) *clavatipes*, sp. nov.
Bifurcation de la posticale située sous la transversale ou à peine en arrière ; fémurs non en massue .. .. 11.
11. Ailes avec 6-7 petites taches noires ; pattes blanches, extrémité des fémurs, des tibias et des trois premiers articles tarsaux noire .. 12. *C.* (*P.*) *punctatipennis*, sp. nov.
Ailes avec 4 petites taches noires ; pattes brunâtres .. .. .. 14. *C.* (*P.*) *graciliforceps*, sp. nov.
12. Pattes blanches, les 4 fémurs antérieurs avec un anneau brun noir, tous les tibias avec 2 anneaux noirs ; bifurcation de la posticale située notablement en arrière de la transversale .. .. 13. *C.* (*P.*) *annulatipes*, sp. nov.
Pattes blanchâtres, sans anneau ; bifurcation de la posticale située sous la transversale ou à peine en arrière .. .. 13.
13. Thorax d'un roux brun, mesonotum parcouru par trois sutures proéminentes en forme d'arête .. .. .. 9. *C.* (*P.*) *tripartitus*, sp. nov.
Thorax noir, ou brun avec deux taches blanchâtres sur le devant du mesonotum, sutures du mesonotum non en arêtes 14.
14. D'un noir mat, sauf les pattes et le pétiole des balanciers ; tibia postérieur à poils guère plus longs que son épaisseur .. 11. *C.* (*P.*) *dolens*, sp. nov.
Brun ; 2 taches sur le devant du mesonotum, antennes, pétiole des balanciers et pattes blanchâtres ; abdomen noir, bord postérieur des segments blanchâtre ; tibia postérieur à poils 2-3 fois aussi longs que son épaisseur .. .. 15. *C.* (*P.*) *curtimanus*, sp. nov.
15. Ailes blanches, avec des stries enfumées le long des nervures et deux bandes longitudinales, transversale noire et bordée de noir 16. *C.* (*P.*) *striatipennis*, sp. nov.
Ailes avec une bande transversale .. 16.

16. Bifurcation de la posticale située notablement en arrière de la transversale ; ailes blanches avec une bande transversale et l'extrémité brunes .. .. .. 17. *C.* (*P.*) *halli*, sp. nov.

Bifurcation de la posticale située sous la transversale ou à peine en arrière ; ailes non brunes à l'extrémité .. .. 17.

17. Nervures du tiers apical de l'aile longées par des bandes enfumées ; ailes blanches avec une bande transversale enfumée .. 18. *C.* (*P.*) *tenuitarsis*, sp. nov.

Nervures non longées par des bandes enfumées 18.

18. Métatarse antérieur deux fois aussi long que le tibia ; ailes hyalines, avec une bande transversale enfumée, brièvement ciliées .. 19. *C.* (*P.*) *fasciatipennis*, sp. nov.

Métatarse antérieur de moitié plus long que le tibia ; ailes blanches, avec une bande transversale enfumée, longuement ciliées .. 20. *C.* (*P.*) *fimbriatus*, sp. nov.

1. *Chironomus camptogaster*, sp. nov.

(Pl. xi, fig. 2, deux derniers articles abdominaux et pince vus de côté.)

♂. Brun ; trochanters, tarses intermédiaires (les autres brisés) et pince jaunâtres ; balanciers blanchâtres ; abdomen d'un brun jaunâtre, plus sombre apicalement. Yeux glabres. Palpes de 4 articles, dont les deux premiers sont courts, le 4e plus long que le 3e, huit fois aussi long que gros. Antennes de 12 articles, dont le 2e est aussi long que gros, le 3e et le 4e transversaux, 5-11 au moins aussi longs que gros ; 12e deux fois aussi long que les articles 2-11 réunis, pointu au bout. Ailes hyalines et finement ponctuées ; extrémité de la nervure auxiliaire située à égale distance du radius et de la transversale ; extrémité du radius située vis-à-vis du milieu du rameau supérieur de la posticale ; extrémité de la 2e nervure deux fois plus éloignée du cubitus que du radius ; cubitus droit, aboutissant assez près de l'extrémité alaire ; transversale oblique ; partie apicale de la discoïdale déviant faiblement de la direction de la partie basale, son extrémité aussi rapprochée de la pointe alaire que le cubitus ; bifurcation de la posticale située en arrière de la transversale, rameau supérieur continuant presque la direction de la tige, l'inférieur très oblique. Peigne des quatre tibias postérieurs en demi-anneau dentelé. Pattes sans longs poils ; empodium un peu plus court que les crochets, avec des poils rameux sur le dessous ; pulvilles à peine plus courts que l'empodium. Abdomen plus de deux fois aussi long que le reste du corps, graduellement aminci en arrière ; 7e segment deux fois aussi long que gros ; 8e plus mince, deux fois aussi long que gros, aminci à sa base en un pédicelle transversal, proéminent en bosse à la base de sa partie ventrale, dirigé obliquement par en haut ; lamelle supérieure

de la pince dépourvue d'appendice linéaire, mais incurvée et amincie au bout ; lamelles intermédiaires grêles, glabres, un peu plus courtes que les inférieures ; celles-ci dépassant à peine le milieu de la pince, arquées, en massue, leur partie renflée est munie de longs poils courbés par en bas ; articles terminaux de la pince plus longs et plus larges que les basaux, lancéolés, glabres, sauf leur côté interne qui est excavé et muni de poils courts et alignés. Taille 3·5 mm.

Calcutta.

2. *Chironomus longivalvis*, sp. nov.

(Pl. xi, fig. 11, partie de la pince.)

♂. D'un jaune brunâtre ; antennes et pince brunes ; genoux d'un brun noir, tarses sombres ; dessus des six premiers segments abdominaux avec une bande longitudinale brune ; segments 7 et 8 bruns en entier. Yeux glabres, distants au vertex. Bouche petite. Palpes de 4 longs articles ; le 4^{e} un peu plus long que le 3^{e}, huit fois aussi long que gros. Antennes de 13 articles ; 3-12 transversaux ; 13^{e} pointu au bout, deux fois aussi long que les articles 2-12 réunis. Ailes hyalines, finement pointillées ; extrémité du radius située vis-à-vis du milieu du rameau supérieur de la posticale ; extrémité de la 2^{e} nervure 3-4 fois plus éloignée du cubitus que du radius ; cubitus droit, aboutissant un peu avant l'extrémité alaire ; transversale petite et oblique, située en avant de la bifurcation de la posticale ; moitié apicale de la discoïdale continuant la direction de la partie basale, son extrémité aussi éloignée de la pointe alaire que le cubitus ; rameau supérieur de la posticale faiblement arqué, continuant presque la direction de la tige, l'inférieur à peine arqué et formant presque un angle droit avec la tige. Pattes sans longs poils ; extrémité des tibias intermédiaires et postérieurs, formant un demi-anneau dentelé et d'un brun noir ; tarses antérieurs brisés ; crochets simples et noirs ; empodium filiforme, plus court que les crochets, avec des poils rameux sur le dessous ; pulvilles aussi longs que l'empodium. Abdomen grêle et long ; lamelle supérieure de la pince prolongée en un appendice linéaire, noir, glabre et trois à quatre fois aussi long que large ; lamelles intermédiaires grêles, graduellement amincies en pointe, arquées, glabres et jaunes ; lamelles inférieures longues, deux fois aussi longues que les intermédiaires et un peu plus courtes que la pince, subcylindriques, à peine plus minces à l'extrémité, leur tiers apical muni de longs poils incurvés par en bas ; article basal de la pince avec un petit lobe au milieu de leur côté interne ; article terminal un peu plus long que le basal, et au moins aussi large que lui, trois fois aussi long que gros, un peu aminci à l'extrémité, muni de poils très courts au côté interne et de poils très longs au côté externe. Taille 4·8 mm.

Calcutta.

3. *hironomus bipunctatus*, sp. nov.

♂. D'un roux jaunâtre ; dernier article antennaire d'un brun noir, panache fauve ; mesonotum blanchâtre, avec 4 bandes longitudinales, dont les deux externes plus larges et raccourcies en avant, les deux internes raccourcies en arrière ; scutellum blanchâtre, avec deux taches noires ; balanciers blancs, massue avec deux points noirs ; pattes d'un blanc jaunâtre ; abdomen et pince bruns. Yeux très arqués, amincis

supérieurement, où ils sont peu distants. Articles du flagellum très transversaux, le dernier trois fois aussi long que les précédents réunis. Ailes blanchâtres, avec des taches très faiblement enfumées et peu distinctes, dont la plus grande longe le dessous de la moitié distale du cubitus ; la 2e est située entre les rameaux de la posticale, la 3e entre le pétiole de la posticale et le bord, la 4e sur la nervure anale inférieure ; en outre, la partie distale de la discoïdale et les deux rameaux de la posticale sont bordés de la même teinte ; nervures pâles, sauf la transversale et la base du cubitus qui sont noires ; auxiliaire aboutissant au bord vis-à-vis de l'extrémité du rameau inférieur de la posticale ; extrémité du radius un peu plus rapprochée de la pointe alaire que le rameau antérieur de la posticale ; cubitus droit, éloigné du bord, non dépassé par la costale, aussi rapproché de la pointe alaire que la discoïdale ; transversale oblique ; bifurcation de la posticale située sous la transversale. Pattes intermédiaires et postérieures avec des poils 3-4 fois aussi longs que leur épaisseur ; tibias antérieurs un peu plus courts que le fémur ; tarses brisés ; 5e article des tarses postérieurs 2-3 fois aussi long que gros ; empodium filiforme ; pulvilles aussi longs que l'empodium, larges, plus courts que les crochets. Abdomen linéaire, deux fois aussi long que le reste du corps ; article terminal de la pince presque deux fois aussi long que le basal, aminci à la base, graduellement aminci dans la moitié terminale qui est glabre sur le dessus, avec des poils dressés et courts sur le dessous. Taille 6 mm.

Rangoon, Burma, en février (N. Annandale).

4. *Chironomus* (*Prochironomus*) *prussicus*, sp. nov.

♂. D'un noir mat ; palpes, balanciers, hanches, pattes et abdomen sauf les trois derniers segments, blancs ; articles de la pince et scape brunâtre ; flagellum brisé ; moitié proximale des fémurs antérieurs noirâtre. Ailes blanchâtres, toutes les nervures pâles ; extrémité du radius plus distante de la pointe alaire que le rameau supérieur de la posticale ; 2e longitudinale nulle ; cubitus rapproché du bord et parallèle à lui, non dépassé par la costale, aboutissant presque à la pointe alaire, dont il est plus rapproché que la discoïdale ; transversale oblique ; bifurcation de la posticale située bien en arrière de la transversale. Fémur et métatarse antérieur de moitié plus longs que le tibia ; 4e article tarsal presque triple du 5e, qui est 5-6 fois aussi long que gros ; tibia des pattes intermédiaires et postérieures avec des poils guère plus longs que son épaisseur. Abdomen grêle, deux fois aussi long que le reste du corps ; le segment pénultième et l'antépénultième un peu élargis ; pince grêle, article terminal lancéolé, deux fois aussi long que l'article basal ; poils de l'abdomen dressés, blanchâtres et peu longs. Taille 3·5 mm.

Simla, altitude de 2,400 m., en mai (N. Annandale).

5. *Chironomus* (*Prochironomus*) *pictiventris*, sp. nov.

♂. D'un blanc pur ; antennes brunes ; scape, trois bandes du mesonotum, dont la médiane est raccourcie en arrière et les deux externes raccourcies en avant, et les pleures, d'un roux brun ; extrémité des fémurs, des tibias et des 3-4 premiers articles

tarsaux noire, 5e article tarsal brunâtre ; les 5 premiers segments abdominaux ont deux taches noirâtres juxtaposées et conformées en U, aussi longues que les segments, et disposées de telle façon que, sur la partie dorsale des segments, les deux taches sont à peine séparées l'une de l'autre, tandis que sur la partie ventrale elles sont très distantes ; les trois derniers segments d'un brun noir, comme la base de la pince ; articles terminaux de la pince blanchâtres. Yeux fortement arqués, amincis supérieurement. Panache gris ; articles du flagellum un peu transversaux, le dernier guère plus long que les précédents réunis. Ailes blanchâtres et irrisées ; toutes les nervures sont pâles ; l'auxiliaire dépasse à peine la transversale ; extrémité du radius à peine plus rapprochée de la pointe alaire que le rameau supérieur de la posticale ; 2e longitudinale nulle ; cubitus droit, distant du bord, non dépassé par la costale, son extrémité 3-4 fois plus distante de la pointe alaire que la discoïdale ; transversale très oblique, située au-dessus de la bifurcation de la posticale. Tibia antérieur égal à la moitié du fémur ; métatarse $2\frac{1}{2}$ fois aussi long que le tibia, 4e article presque triple du 5e, qui est 4 fois aussi long que gros ; tibia postérieur un peu plus long que le métatarse ; pattes intermédiaires et postérieures longuement poilues. Abdomen également mince, poilu, deux fois aussi long que le reste du corps. Taille 3·5 mm.

Bettiah, Champaran, Bengal, mars.

6. *Chironomus* (*Prochironomus*) *annandalei*, sp. nov.

(Pl. ix, fig. 10, anneau dentelé du tibia postérieur ; fig. 11, dernier article du tarse antérieur.)

♀. Brun ; tête et thorax plus clairs ; hanches, pattes, palpes et antennes d'un jaune brunâtre ; balanciers d'un blanc jaunâtre. Yeux glabres, très rapprochés supérieurement, où ils sont un peu amincis et à peine découpés au côté interne. Articles des palpes cylindriques, $1\frac{1}{2}$, 2, 4 et 7 fois aussi longs que gros. Antennes composées de cinq articles, dont le 2e est allongé, rétréci au milieu, terminé par un col égal au tiers de sa longueur ; articles 3 et 4 formés par une nodosité subovoïdale terminée par un col aussi long qu'elle ; 5e article subovoïdal, terminé par un prolongement subfusiforme, trois fois aussi long que la nodosité, orné de deux longues soies à l'extrémité et de deux autres plus courtes au milieu ; verticilles de poils 2 à 3 fois aussi longs que les articles ; au-dessus du verticille, les articles 2 à 5 portent deux appendices subuliformes, hyalins, de la longueur de l'article. Ailes hyalines, ponctuées ; radius et cubitus avec des soies, la 2e nervure manque ; cubitus arqué et parallèle au bord antérieur de l'aile, aboutissant à l'extrémité alaire, bord costal s'arrêtant à cet endroit ; transversale oblique ; discoïdale faiblement arquée par en bas à partir de la transversale, son extrémité également distante du cubitus et de la posticale ; bifurcation de la posticale située un peu au delà de la transversale, rameau supérieur à peine arqué, continuant la direction de la tige, l'inférieur non arqué, oblique. Extrémité des quatre tibias postérieurs avec un anneau noir, dentelé comme le grand éperon ; poils des tibias deux fois aussi longs que l'épaisseur du tibia ; tarses antérieurs brisés ; les postérieurs 14, 10, 8, 5, 3 fois aussi longs que gros ; empodium filiforme, aussi long que les crochets, à

deux rangées de poils sur le dessous ; pulvilles très petits. Abdomen un peu plus long que le reste du corps, graduellement élargi de la base au milieu ; lamelles très petites. Taille 2 mm.

Calcutta, juillet 1907 (Annandale).

7. *Chironomus* (*Prochironomus*) *albiforceps*, sp. nov.

♂. D'un noir brillant et glabre ; antennes et panache d'un brun noir ; métatarse antérieur d'un blanc pur sauf le quart distal ; 3-4 premiers articles des quatre autres tarses sauf leur extrémité, trochanters, base du pétiole des balanciers et article de la pince d'un blanc sâle. Yeux séparés seulement par une ligne au vertex et à la face. Antennes de 13 articles ; les articles 3-12 transversaux, le 13^{e} presque deux fois aussi long que les 11 précédents réunis. Palpes de 4 articles médiocrement longs. Thorax pointu en avant et recouvrant la tête. Ailes glabres, légèrement enfumées et irrisées, nervures noires ; extrémité du radius bien plus rapprochée de la pointe alaire que le rameau inférieur de la posticale ; 2^{e} longitudinale faiblement marquée, son extrémité plus éloignée du cubitus que du radius ; cubitus droit, éloigné du bord, non dépassé par la costale, son extrémité aussi rapprochée de la pointe alaire que la discoïdale ; transversale perpendiculaire et petite ; bifurcation de la posticale située à peine en arrière de la transversale. Tibias antérieurs un peu plus courts que la moitié du métatarse, 5^{e} article quatre fois aussi long que gros, atteignant à peine la moitié du 4^{e} ; quatre tibias postérieurs médiocrement ciliés ; articles tarsaux avec de courtes soies sur le dessous, empodium filiforme, beaucoup plus long que les pulvilles, plus court que les crochets. Abdomen grêle, presque deux fois aussi long que le reste du corps, poilu de noir ; pince à articles terminaux très grêles, plus de deux fois aussi longs que les articles basaux, amincis dans leur moitié proximale. Taille 2·6 mm.

Calcutta, en août, 7 exemplaires.

8. *Chironomus* (*Prochironomus*) *atripes*, sp. nov.

♀. Couleur du précédent, dont il est peut-être l'autre sexe et dont il diffère par les caractères suivants : antennes de 5 articles, le 2^{e} cylindrique, plus long que le 3^{e} ; 3^{e} et 4^{e} globuleux, à col aussi long qu'eux ; 5^{e} globuleux, à col subcylindrique aussi long que les deux articles précédents réunis. Ailes fortement enfumées avec des taches hyalines, à savoir : 1er une grande tache à l'extrémité distale, 2^{e} l'espace compris entre le cubitus et la posticale, 3^{e} une tache sur le bord inférieur entre les deux rameaux de la posticale, 4^{e} une grande tache sous le tiers distal du pétiole de la posticale, depuis le bord inférieur de l'aile jusqu'au pétiole ; cubitus arqué et rapproché de la costale à laquelle il est parallèle. Tibias antérieurs un peu plus longs que la moitié du métatarse. Taille 2·3 mm.

Katihar, Distr. Purneah, en août (C. Paiva).

9. *Chironomus* (*Prochironomus*) *tripartitus*, sp. nov.

♀ ♂. Thorax d'un roux brun, mat et glabre ; face blanchâtre ; antennes d'un brun noir, les trois premiers articles, les hanches, les pattes et la pince anale blanchâtres ;

balanciers blancs; parfois les 4 derniers articles des tarses antérieurs, les deux derniers des tarses intermédiaires et les trois derniers avec la moitié distale du 2e aux tarses postérieurs, assombris; abdomen d'un gris brunâtre, bord postérieur des tergites plus clair. Yeux fortement arqués, faiblement amincis en haut, où ils sont distants de leur largeur. Antennes de la femelle composés de 5 articles, dont le 2e est rétreci au milieu et deux fois aussi long que le 3e, les deux suivants en ovoïde court, avec un col plus court que la partie renflée ; le 5e en ovoïde court, avec un col aussi long que les articles 3 et 4 réunis, étroit et graduellement aminci. Le mâle a le panache d'un brun noir, les articles du flagellum transversaux, sauf le dernier qui est un peu plus long que les précédents réunis. Mesonotum à sutures latérales et suture médiane fortement marquées paraissant être traversé par trois arêtes. Ailes blanches, avec 8 taches enfumées, dont trois sont situées entre le cubitus et la discoïdale, la 1e sous l'origine du cubitus et dépassant un peu la discoïdale, la 2e sous le milieu du cubitus et la 3e sous l'extrémité du cubitus ; la 4e tache est située à l'extrémité de la discoïdale, la 5e entre la discoïdale et le milieu du rameau supérieur de la posticale, la 6e dans la bifurcation de la posticale et se continue, en fine bande, le long du rameau inférieur jusqu'au bord alaire, qu'elle longe sur un court espace proximalement ; la 7e et la 8e sont également distantes du pétiole de la posticale et du bord postérieur de l'aile ; 2e nervure longitudinale 4-5 fois plus éloignée de l'extrémité du cubitus que du radius ; cubitus éloigné du bord, presque droit, non dépassé par la costale, aussi rapproché de la pointe alaire que la discoïdale ; transversale oblique ; bifurcation de la posticale située à peine distalement de la transversale ; extrémité du rameau antérieur un peu plus loin de la pointe alaire que la 2e longitudinale. Pattes de la femelle sans longs poils ; métatarse antérieur de moitié plus long que le tibia ; 5e article égal à la moitié du 4e, 3-4 fois aussi long que gros ; tibias postérieurs de moitié plus long que le métatarse ; empodium filiforme, pulvilles petits ; le mâle a les tibias et les tarses des 4 pattes postérieures munis de poils trois fois aussi longs que leur épaisseur. Abdomen de la femelle faiblement déprimé, un peu plus long que le reste du corps ; celui du mâle plus de deux fois aussi long que le reste du corps; article terminal de la pince aussi gros et aussi long que le basal, faiblement incurvé et d'égale largeur sauf à l'extrémité distale, qui est à peine plus mince. Taille 2·5 mm.

Capturé pendant la nuit, à bord d'un vaisseau, dans le canal de Suez, le 9 octobre 1907 ; 8 exemplaires (N. Annandale).

10. *Chironomus* (*Prochironomus*) *clavatipes*, sp. nov.

♂. Noir ; antennes, panache et pince bruns ; balanciers blanchâtres ; fémurs antérieurs bruns au tiers distal, plus clairs dans les deux tiers proximaux ; les quatre autres fémurs bruns, avec un anneau clair à leur extrémité ; tibias bruns, les quatre postérieurs avec l'extrémité noire et un petit anneau clair avant l'extrémité ; tarses blancs, 5e article et extrémité des 4 autres noirs. Articles du flagellum aussi longs que gros, le dernier à peine plus long que les précédents réunis. Ailes blanches, avec des taches noirâtres, irrisées, grandes et bien délimitées, dont 4 sont allongées, à savoir 3 formant ensemble une bande transversale et situées l'une entre le cubitus et la discoïdale,

sous l'extrémité du radius, l'autre entre la discoïdale et le rameau supérieur de la posticale, la 3e entre ce rameau et le bord inférieur de l'aile ; la 4e est située sous le milieu du pétiole de la posticale et est divisée, par une ligne longitudinale, en deux parties inégales ; les autres taches sont petites ; deux se trouvent à l'extrémité alaire, l'une entre le cubitus et la discoïdale, l'autre entre la discoïdale et le rameau antérieur de la posticale ; une autre est située à la bifurcation de la posticale ; en outre, la région comprise entre la costale et la posticale, depuis la base de l'aile jusqu'à la bifurcation de la posticale, est légèrement enfumée ; nervures jaunes en entier ; radius aboutissant vis-à-vis du milieu du rameau supérieur de la posticale ; la 2e longitudinale est quatre fois plus rapprochée du radius que du cubitus ; celui-ci droit, non dépassé par la costale, aboutissant presque aussi près de la pointe alaire que la discoïdale ; transversale oblique, située bien en deçà de la bifurcation de la posticale ; rameau supérieur plus distant de l'inférieur que de la pointe alaire. Fémurs antérieurs renflés dans leur tiers distal, au moins deux fois aussi longs que les tibias ; métatarse 2½ fois aussi long que le tibia, 4e article tarsal plus de deux fois le 5e ; tibia postérieur avec des poils deux fois aussi longs que son épaisseur. Abdomen grêle ; pince petite ; articles terminaux guère plus longs que les basaux, presque coniques, avec quelques courtes soies au côté interne et quelques longs poils au côté externe. Taille 2·8 mm.

"Between Manihari and Manshahi, E. B. S. Ry., Bengal, on railway track," 4-viii-07 (C. Paiva).

11. *Chironomus* (*Prochironomus*) *dolens*, sp. nov.

♀. D'un noir mat, y compris la bouche et les palpes ; pétiole des balanciers et pattes blanchâtres, fémurs sauf l'extrémité, et tibias intermédiaires sauf l'extrémité, nodosités des antennes et col du 5e article, bruns ; mesonotum pruineux sur les côtés. Antennes de 5 articles ; les articles 3-5 globuleux, avec un col aussi long que le renflement, sauf au 5e article, où il est subcylindrique et deux à trois fois aussi long que l'article ; verticilles deux fois aussi longs que les articles. Ailes blanches, avec des taches enfumées, dont trois sont situées entre le cubitus et la discoïdale, à savoir une sous l'origine du cubitus, une sous l'extrémité de la 2e longitudinale, et l'autre, allongée en trait et bifurquée, sous l'extrémité du cubitus ; une petite tache se trouve au-dessus du quart apical du rameau supérieur de la posticale ; deux dans la fourche de la posticale l'une à la base et l'autre à l'extrémité du rameau inférieur ; une autre sous la bifurcation de la posticale, et une entre le pétiole et le bord inférieur ; nervures jaunes ; l'auxiliaire dépasse notablement la transversale ; extrémité du radius à peine plus près de la pointe alaire que le rameau inférieur de la posticale ; 2e longitudinale deux fois plus distante du cubitus que du radius à son extrémité ; cubitus presque droit, distant de la costale et non dépassé par elle, deux fois plus distant de la pointe alaire que la discoïdale ; bifurcation de la posticale située à peine en arrière de la transversale. Tibias antérieurs d'un tiers plus courts que le fémur ou que le métatarse, 4e article au moins double du 5e, qui est 5-6 fois aussi long que gros ; tibia des pattes postérieurs à poils guère plus longs que son épaisseur. Abdomen un peu plus long que le reste du corps, presque glabre, un peu comprimé, ayant sa plus grande hauteur au milieu. Taille 3·8 mm.

Calcutta, capturé à la lumière, en janvier (N. Annandale) ; une variété avec une bande médiane rousse sur la moitié antérieure du mesonotum ; base des Dawna Hills, en mars (N. Annandale).

12. *Chironomus* (*Prochironomus*) *punctatipennis*, sp. nov.

♀ ♂. D'un brun roux ; balanciers, hanches et pattes blanchâtres ; dernier article antennaire de la femelle, extrémité des fémurs, des tibias et des trois premiers articles tarsaux noirs, articles tarsaux 4 et 5 bruns; panache du mâle fauve, noirâtre avant l'extrémité; mesonotum d'un blanc jaunâtre, avec trois bandes confluentes d'un brun roux, la médiane raccourcie en arrière, les latérales raccourcies en avant. Article 2e des antennes de la femelle, subcylindrique, à peine deux fois aussi long que gros; 3-5 ovoïdaux, sans col, sauf le 5e qui se termine en un prolongement mince, cylindrique, trois fois aussi long que la nodosité, verticilles très courts. Articles du flagellum du mâle très transversaux, sauf le dernier qui est plus de deux fois aussi long que les précédents réunis. Ailes blanches, avec 6-7 petites taches noires, circulaires et très bien délimitées, dont la plus grande est située sur la transversale ; la 2e entre le cubitus et la discoïdale, sous l'extrémité du radius ; la 3e se trouve sous la 2e, entre la discoïdale et le rameau supérieur de la posticale ; la 4e entre les deux rameaux de la posticale ; les deux ou trois autres entre le pétiole de la posticale et le bord inférieur de l'aile; un petit trait enfumé réunit la 2e tache à la pointe alaire ; nervures pâles ; extrémité du radius un peu plus distante de la pointe alaire que le rameau supérieur de la posticale ; 2e longitudinale nulle ; cubitus presque droit, assez distant du bord, non dépassé par la costale, aboutissant très près de la pointe alaire, à peine plus loin que la discoïdale; transversale oblique, située à peine en avant de la bifurcation de la posticale. Tibia antérieur d'un tiers plus court que le fémur, à peine plus long que la moitié du métatarse ; 4e article presque deux fois aussi long que le 5e qui est quatre fois aussi long que gros ; chez le mâle, comme chez la femelle, les pattes sont dépourvues de longs poils. Abdomen de la femelle grêle, subcylindrique, deux fois aussi long que le reste du corps. Taille 2·5 mm.

Rajmahal, Bengal, en juillet ; Puri, Orissa Coast, en mars (C. Paiva) ; Katihar, Distr. Purneah, en août (C. Paiva).

13. *Chironomus* (*Prochironomus*) *annulatipes*, sp. nov.

♀. D'un brun noir ; antennes jaunâtres, nodosité des articles 3-5 noire ; balanciers, pattes et mince bord postérieur des segments abdominaux blanchâtres ; les 4 fémurs antérieurs avec un anneau d'un brun noir près de leur extrémité ; fémurs postérieurs d'un brun noir, avec un large anneau jaune au-dessus du milieu ; tibias de toutes les pattes avec deux anneaux d'un brun noir ; tarses antérieurs bruns, extrémité des trois premiers articles plus claire ; aux quatre autres tarses les articles sont bruns, tiers distal des trois premiers articles jaune. Article 2e des antennes rétréci au milieu, formé de deux nodosités confluentes ; articles 3-5 globuleux, avec un col aussi long que la nodosité, sauf le 5e, qui se termine en un prolongement mince, cylindrique, deux fois aussi long que le 4e article. Ailes blanchâtres, avec des taches enfumées

dont deux sont situées entre le cubitus et la discoïdale, à savoir une plus grande sous l'origine du cubitus, et l'autre sous l'extrémité du radius ; entre la discoïdale et le rameau supérieur de la posticale se trouve un trait longitudinal, et, au bord alaire, une petite tache transversale ; une grande tache occupe tout l'espace compris entre les deux rameaux de la posticale et s'étend encore de la base du rameau inférieur jusqu'au bord postérieur de l'aile ; en son centre, cette tache renferme un petit espace blanc et circulaire ; un mince trait réunit le milieu du pétiole au bord postérieur de l'aile ; 2e nervure longitudinale très rapprochée du radius, de laquelle elle est 4-5 fois plus proche que du cubitus ; celui-ci presque droit, distant du bord, non dépassé par la costale, aboutissant presque aussi près de la pointe alaire que la discoïdale ; extrémité du rameau supérieur de la posticale deux fois plus distant de l'inférieur que de la posticale ; transversale oblique, située notablement en avant de la bifurcation de la posticale. Tibia antérieur égal à la moitié du fémur, à peine plus long que la moitié du métatarse ; 4e article tarsal deux fois aussi long que le 5e qui est 4-5 fois aussi long que gros ; aux autres pattes, le tibia est deux fois aussi long que le métatarse, lequel est un peu plus gros que les articles suivants ; 4e article deux fois aussi long que gros, à peine plus long que le 5e. Taille 2 mm.

Puri, côte d'Orissa, en mars (C. Paiva).

14. *Chironomus* (*Prochironomus*) *graciliforceps*, sp. nov.

♂. D'un brun noir ; pattes brunâtres, extrémité des fémurs, milieu des tibias et tous les tarses assombris ; antennes et panache bruns. Articles du flagellum aussi longs que gros, le dernier un peu plus court que les précédents réunis. Ailes blanches, avec 4 taches noires, circulaires, petites et bien délimitées, dont une entre la base du cubitus et la discoïdale, une entre le milieu du cubitus et la discoïdale, une sur la base du rameau inférieur de la posticale, et une entre le milieu du pétiole et le bord postérieur de l'aile ; nervures jaunes ; radius aboutissant vis-à-vis de l'extrémité du rameau inférieur de la posticale ; 2e longitudinale faible, rapprochée du radius ; cubitus distant du bord, presque droit, aboutissant plus près de la pointe alaire que la discoïdale ; rameau antérieur de la posticale plus près du rameau postérieur que de la pointe alaire ; bifurcation située sous la transversale. Fémur antérieur de moitié plus long que le tibia ; tarses antérieurs brisés ; 5e article des tarses postérieurs deux fois aussi long que gros ; empodium et pulvilles égalant la moitié des crochets. Abdomen grêle ; pince très grêle ; article terminal deux fois aussi long que l'article basal, les deux tiers antérieurs très minces, presque filiformes, le tiers postérieur faiblement fusiforme. Taille 1·5 mm.

"Between Bolpore and Rampore Haut, E. I. Ry., Bengal, at light in railway carriage," 3-viii-07 (C. Paiva).

15. *Chironomus* (*Prochironomus*) *curtimanus*, sp. nov.

♀. Brun ; une tache de chaque côté sur le devant du mesonotum, antennes sauf l'appendice terminal du 5e article, pétiole des balanciers et pattes blanchâtres ; abdomen noir, bord postérieur des segments blanchâtre. Antennes de 5 articles, dont

le 2e est rétréci au milieu ; 3-5 en ellipse courte, col plus court que la nodosité, sauf au 5e article, où il est subfusiforme, presque deux fois aussi long que la nodosité et muni de 2-3 longues soies au bout ; verticilles deux fois aussi longs que les articles. Mesonotum avec 3 fortes sutures. Ailes blanchâtres, avec des taches enfumées, dont une grande sous l'origine du cubitus et dépassant un peu la discoïdale ; une 2e sous le milieu du cubitus et n'atteignant pas la discoïdale ; un petit trait allongé entre le cubitus et la discoïdale près de la pointe alaire ; une tache le long du bord à l'extrémité de la discoïdale ; une autre, très petite et peu distincte, sous la 2e, entre la discoïdale et le rameau supérieur de la posticale ; une située sur la bifurcation de la posticale et longeant ensuite le rameau inférieur jusqu'à l'extrémité ; une entre la nervure anale et le tiers distal du pétiole de la posticale ; une entre le milieu du pétiole et le bord postérieur ; nervures jaunâtres ; extrémité du radius également distant de l'extrémité des deux rameaux de la posticale ; la 2e longitudinale manque ; cubitus presque droit, non dépassé par la costale, un peu plus rapproché de la pointe alaire que la discoïdale ; transversale oblique, située au-dessus de la bifurcation de la posticale. Tibia antérieur un peu plus court que le fémur ; métatarse d'un tiers plus long que le tibia ; 4e article tarsal presque double du 5e qui est 3-4 fois aussi long que gros ; tibias et tarses, sauf aux pattes antérieures, à poils 2 à 3 fois aussi longs que leur épaisseur. Abdomen de moitié plus long que le reste du corps. Taille 3 mm.

Mandalay, U. Burma, en mars (N. Annandale).

16. *Chironomus* (*Prochironomus*) *striatipennis*, sp. nov.

♀. Brun ; tête et antennes roussâtres, nodosités des antennes noirâtres ; mesonotum d'un gris blanchâtre, avec 4 bandes d'un brun roux, les deux médianes séparées par une ligne et raccourcies en arrière, les deux latérales raccourcies en avant ; scutellum d'un gris blanchâtre ; balanciers blancs ; pattes blanchâtres, extrémité des 3 ou 4 premiers articles tarsaux et le dernier ou les deux derniers en entier d'un brun noir. Antennes de 5 articles, dont le 2e est rétréci au milieu ; 3-5 ellipsoïdaux, plus longs que leur col, sauf le 5e, dont l'appendice terminal est de moitié plus long que la nodosité ; verticilles 2-3 fois aussi longs que l'épaisseur des articles. Ailes blanchâtres, avec des stries enfumées le long de la partie distale de la discoïdale, de la posticale et de ses deux rameaux, de l'anale et le long du bord du lobe anal ; en outre, deux bandes longitudinales et étroites sont situées l'une distalement de l'autre, entre le cubitus et la discoïdale ; nervures jaunâtres ; transversale, base du cubitus et de la partie distale de la discoïdale noires et bordées de noirâtre ; extrémité du radius également distante de l'extrémité des deux rameaux de la posticale ; cubitus à peine arqué, non dépassé par la costale, distant du bord, aussi rapproché de la pointe alaire que la discoïdale ; transversale oblique, située un peu en avant de la bifurcation de la posticale. Tibia antérieur égalant les trois quarts du fémur ; métatarse double du tibia ; 4e article tarsal plus de deux fois le 5e, celui-ci six fois aussi long que gros ; aux pattes postérieurs, le 4e article est de moitié plus long que le 5e, qui est 3-4 fois aussi long que gros. Abdomen presque deux fois aussi long que le reste du corps. Taille 4·5 mm.

Bhim Tal, Kumaon, altitude de 1,500 m., en septembre (N. Annandale).

17. *Chironomus* (*Prochironomus*) *halli*, sp. nov.

♀. D'un brun roux ; antennes et pattes d'un blanc jaunâtre ; mince anneau avant l'extrémité des fémurs et au-dessus de la base du tibia, et l'extrémité des 4 premiers articles tarsaux intermédiaires et postérieurs d'un brun noir ; balanciers roussâtres ; mesonotum pruineux de gris, moitié postérieure avec trois bandes blanches ; bord postérieur des segments abdominaux 3-7 blanchâtre. Antennes de 5 articles ; le 2e composé de deux nodosités ; 3-5 ellipsoïdaux, avec un col plus court que la nodosité, sauf au 5e, dont l'appendice terminal est presque triple de la nodosité ; verticilles 2-3 fois aussi longs que l'article. Ailes blanches, irrisées, avec l'extrême bout distal et une mince bande transversale bruns, cette bande a comme limite distale l'extrémité du rameau postérieur de la posticale, et comme limite proximale la bifurcation de la posticale ; radius un peu plus rapproché de la pointe alaire que le rameau postérieur de la posticale ; 2e longitudinale peu distincte et très rapprochée du radius ; cubitus légèrement arqué, non dépassé par la costale, aboutissant aussi près de la pointe alaire que la discoïdale ; transversale oblique ; rameau antérieur de la posticale plus rapproché de la pointe alaire que du rameau postérieur ; bifurcation située notablement en arrière de la transversale. Tibia antérieur guère plus court que le fémur, métatarse de moitié plus long que le tibia, 4e article presque triple du 5e, qui est 6 fois aussi long que gros ; aux pattes postérieures, le métatarse est à peine plus long que le tibia, le 4e article tarsal presque double du 5e, celui-ci 3 fois aussi long que gros. Abdomen allongé, un peu déprimé, de moitié plus long que le reste du corps. Taille 3·5 mm.

Sylhet, Assam, 9-ii (Major Hall).

18. *Chironomus* (*Prochironomus*) *tenuitarsis*, sp. nov.

♀. Jaunâtre ; une bande raccourcie sur chaque côté du mesonotum d'un roux brun ; deux taches obliques sur le metanotum et tiers postérieur de l'abdomen bruns ; aux pattes antérieures, l'extrémité des fémurs, la base et l'extrémité des tibias, l'extrémité des 2 ou 3 premiers articles tarsaux noirâtres, les deux ou trois derniers articles tarsaux d'un brun noir ; aux autres pattes, les deux derniers articles tarsaux sont assombris ; balanciers blanchâtres ; palpes bruns ; antennes brunâtres. Yeux très arqués, amincis au tiers supérieur, où ils sont distants de leur largeur. Antennes plus courtes que les palpes, de 5 articles, dont le 2e est presque cylindrique, pas distinctement rétréci au milieu, deux fois aussi long que gros ; 3-5 ovoïdaux, à col aussi long que la nodosité, sauf au 5e article, dont l'appendice terminal est deux fois aussi long que la nodosité et un peu renflé au milieu ; verticilles deux fois aussi longs que les articles. Ailes blanches, avec une bande transversale, large, enfumée et irrisée, dont les limites proximales sont la transversale et la bifurcation de la posticale, et la limite distale l'extrémité du rameau inférieur de la posticale ; au bord postérieur de l'aile, cette teinte est prolongée proximalement jusque vis-à-vis du milieu du pétiole ; au bord antérieur de l'aile, cette bande renferme un petit espace blanchâtre qui s'étend jusqu'au cubitus ; dans le quart distal, le cubitus, la discoïdale et le rameau supérieur de la posticale sont longés par une mince bande enfumée ; nervures jaunes, sauf dans la

teinte enfumée ; auxiliaire dépassant un peu la transversale ; radius à peine plus distant de la pointe alaire que le rameau antérieur de la posticale ; 2e longitudinale peu distincte, très proche du radius ; cubitus presque droit, distant du bord, deux fois plus rapproché de la pointe alaire que la discoïdale, non dépassé par la costale ; transversale oblique, située au-dessus de la bifurcation de la posticale. Tibia antérieur égal au fémur ; métatarse de moitié plus long que le tibia ; 4e article tarsal double du 5e, celui-ci 5-6 fois aussi long que gros. Taille 2·5 mm.

Rangoon, Burma, en février ; Mandalay, Upper Burma, en mars (N. Annandale).

19. *Chironomus* (*Prochironomus*) *fasciatipennis*, sp. nov.

(Pl. xi, fig. 4, deux derniers articles antennaires.)

♀. Jaune ; metanotum sauf une ligne médiane, et bande transversale sur les segments abdominaux 2, 3, 5 et 6, bruns. Yeux réniformes et glabres. Palpes à articles cylindriques, base simulant un premier article, deux fois aussi longue que grosse ; articles 1, 2 et 4 trois à quatre fois aussi longs que gros ; 3e de moitié plus long que le 4e. Antennes de 5 articles ; 2e article allongé, rétréci au milieu, avec un col égal au tiers de sa longueur ; articles 3 et 4 ovoïdaux, avec un col aussi long qu'eux ; 5e en ovoïde court, avec un col $3\frac{1}{2}$ fois aussi long que lui et terminé par trois longues soies ; verticilles de soies trois fois aussi longs que les articles, sauf au 5e, où il dépasse à peine l'extrémité du col ; le 2e article porte deux verticilles de soies ; appendices subuliformes, hyalins, dépassant un peu la base de l'article suivant, situés au nombre de deux sur les articles 2 à 5. Ailes hyalines, avec une large bande transversale enfumée et irrisée, qui occupe la moitié basale de l'aile, sauf l'extrême base ; surface ponctuée parsemée de soies plus longues ; sous-costale, radius et cubitus armés de soies ; extrémité du radius située presque vis-à-vis de l'extrémité du rameau supérieur de la posticale ; 2e nervure non indiquée, cubitus légèrement arqué, parallèle au bord, aboutissant à la pointe de l'aile ; discoïdale un peu arquée par en bas, à partir de la transversale qui est oblique ; bifurcation de la posticale située à peine en arrière de la transversale ; rameau supérieur continuant la direction de la tige, à peine arqué, son extrémité un peu plus proche de la discoïdale que du rameau inférieur, qui est oblique. Quatre tibias postérieurs terminés par un anneau brun et dentelé ; métatarse antérieur égal au fémur, deux fois aussi long que le tibia, égal aux articles 2 et 3 réunis ; 4e article double du 5e, qui est 4 fois aussi long que gros ; empodium filiforme, un peu plus court que les crochets, à deux rangées de poils sur le dessous ; pulvilles n'atteignant pas le milieu des crochets. Abdomen pas plus long que le reste du corps, un peu comprimé, graduellement aminci aux deux bouts ; lamelles un peu plus longues que larges. Taille 1·5 mm.

Calcutta, en janvier, février, juillet et août (N. Annandale).

20. *Chironomus* (*Prochironomus*) *fimbriatus*, sp. nov.

♀. D'un blanc jaunâtre ou verdâtre ; palpes et antennes d'un brun noir, scape, col des articles suivants, balanciers, tous les tarses, et tibias antérieurs sauf un large

anneau brun près de leur base, blancs ; milieu des fémurs et moitié proximale des 4 tibias postérieurs brunâtres ; mesonotum avec 4 taches brunes allongées, les deux externes occupent la moitié postérieure en forme de bandes étroites, les deux internes sont en ovale allongée, un peu divergentes en arrière, situées de chaque côté de la ligne médiane après le quart antérieur ; metanotum brun, sauf une ligne longitudinale jaune ; tiers médian de l'abdomen brunâtre. Palpes au moins aussi longs que les antennes, à articles cylindriques. Antennes de 5 articles ; le 2e presque deux fois aussi long que gros, rétréci au milieu, sans col ; 3-5 en ellipse raccourcie, avec un col aussi long que la nodosité, au 5e article, ce col est subcylindrique, plus long que la nodosité, terminé par deux longues soies divergentes ; verticilles deux fois aussi longs que les articles. Ailes glabres, finement pointillées, blanches, avec une bande transversale enfumée et irrisée, qui a comme limite proximale l'origine du cubitus et la bifurcation de la posticale, et comme limite distale l'extrémité du radius et du rameau inférieur de la posticale ; au bord inférieur de l'aile cette bande s'avance proximalement, entre la posticale et le bord jusqu'au milieu du pétiole de la posticale, cette partie enclave une petite tache blanche ; en outre, tout l'espace compris entre la costale et la partie proximale de la discoïdale est enfumé ; bord postérieur élégamment cilié, ces cils plus longs que d'ordinaire, de forme lancéolée ; auxiliaire dépassant de beaucoup la transversale ; extrémité du radius un peu plus rapprochée de la pointe alaire que le rameau supérieur de la posticale ; 2e longitudinale très près du radius ; cubitus droit, aboutissant à la pointe ou presque à la pointe de l'aile, non dépassé par la costale ; transversale oblique ; bifurcation de la posticale située sous la transversale ; base de l'aile avec un lobe presque rectangulaire, comme chez tous les congénères décrits ici. Métatarse antérieur de moitié plus long que le tibia ; 5e article entre 5-6 fois aussi long que gros ; empodium filiforme, atteignant les deux tiers des crochets ; pulvilles larges et atteignant la moitié des crochets ; fémurs et tibias des 4 pattes postérieures avec des poils deux fois aussi longs que leur épaisseur. Taille 3 mm.

Charbani, Nepal, en novembre.

2e Genre, TANYTARSUS, V. d. Wulp.

Quatre tibias postérieurs terminés par un anneau dentelé et interrompu ; métatarse antérieur plus long que le tibia ; ailes poilues ou parsemées de soies, ordinairement non lobées à leur base ; cubitus formant ordinairement une ligne droite avec la partie proximale de la discoïdale.

1. Pulvilles nuls .. .. .. 2.
   Pulvilles distincts, plus courts que l'empodium (sous-genre *Micropsectra*) .. 5. *T.* (*M.*) *indicus*, sp. nov.
2. Métatarse intermédiaire renflé en massue et un peu incurvé ; d'un jaune brunâtre .. 1. *T. clavatitarsis*, sp. nov.
   Métatarse intermédiaire cylindrique, non renflé 3.
3. Ailes non lobées, mais graduellement rétrécies à la base .. .. .. 4.

	Ailes lobées à la base, le bord postérieur formant un angle obtus à la base ..	.. 3. *T. breviventris*, sp. nov.
4.	Surface alaire parsemée de soies ..	.. 2. *T. setosipennis*, sp. nov.
	Surface alaire poilue ..	.. 4. *T. pilosipennis*, sp. nov.

1. *Tanytarsus clavatitarsis*, sp. nov.

(Pl. ix, fig. 5, deux premiers articles des tarses intermédiaires.)

♀. D'un jaune brunâtre, thorax d'un brun clair. Yeux glabres, distants supérieurement, où ils n'ont que le tiers de la largeur de la base. Palpes à article 4^{e} aussi long que les deux précédents réunis, ceux-ci trois fois aussi longs que gros. Antennes composées de cinq articles, dont le 2^{e} est rétréci au milieu et porte deux verticilles ; 3^{e} et 4^{e} deux fois aussi longs que gros au milieu, amincis aux deux bouts ; 5^{e} mince, subcylindrique, un peu renflé sous le milieu, presque aussi long que les trois précédents réunis, avec une longue soie au renflement et une près de l'extrémité ; articles 3 et 4 avec un verticille de soies deux à trois fois aussi longues que l'article ; appendices sensoriels des articles 2-4 subuliformes. Ailes non lobées mais graduellement rétrécies à la base, hyalines, ponctuées, parsemées de poils ; nervure auxiliaire atteignant le bord où elle est également distante de l'extrémité du radius et de la base du cubitus ; 2^{e} nervure indistincte ; cubitus formant une ligne droite avec la base de la discoïdale, son extrémité beaucoup plus rapprochée du sommet alaire que celle du rameau supérieur de la fourche, mais plus éloignée que celle de la discoïdale ; celle-ci arquée à l'origine du cubitus et formant un angle avec sa partie basale, aboutissant un peu en-dessous du sommet alaire ; bifurcation de la fourche située en-dessous de la nervure transversale qui est réduite à un point. Tibias antérieurs sans anneau dentelé ; tarses antérieurs et postérieur brisés ; les quatre autres tibias terminés par un anneau dentelé, noir et incomplet ; métatarse intermédiaire renflé en massue et un peu incurvé (pl. ix, fig. 5), muni sur le dessous, outre les poils, de minimes soies courbées en crochet, 2^{e} article n'atteignant pas la moitié du métatarse, les deux derniers égaux, trois fois aussi longs que gros ; empodium filiforme, cilié sur le dessous ; pulvilles nuls. Abdomen guère plus long que la tête et le thorax réunis, faiblement aminci aux deux bouts. Taille 1·8-2 mm.

Calcutta, juillet.

2. *Tanytarsus setosipennis*, sp. nov.

♂. Jaunâtre ; tache ou anneau après le premier et le deuxième tiers de l'abdomen, tache sur les arceaux ventraux et lamelle de la pince, bruns. Yeux glabres, distants au vertex. Ailes hyalines, ponctuées et parsemées de soies, non lobées à la base ; les grosses nervures avec des soies ; nervure auxiliaire dépassant un peu la transversale ; extrémité du radius située vis-à-vis de l'extrémité du rameau antérieur de la posticale ; cubitus droit, continuant la direction de la base de la discoïdale, aboutissant à la pointe alaire ou à peine avant la pointe ; discoïdale faiblement arquée par en bas à partir de la transversale, qui est ponctiforme ; posticale bifurquée en-dessous de la transversale, rameaux non arqués, le supérieur continuant la direction de la tige, l'inférieur très oblique. Quatre tibias postérieurs terminés par un anneau dentelé brun, grand éperon arqué

faiblement, non dentelé ; poils des pattes 2 à 3 fois aussi longs que leur épaisseur ; tarses antérieurs brisés ; aux postérieurs, le métatarse est double du 2e article, qui est à peine plus long que le 3e ; 4e d'un tiers plus court que le 3e, double du 5e, qui est trois fois aussi long que gros ; empodium aussi long que les crochets, filiforme, avec deux rangées de poils sur le dessous. Abdomen deux fois et demie aussi long que le reste du corps, cylindrique, grêle, à segments allongés ; lamelle supérieure de la pince triangulaire, dépassant les articles basaux ; articles terminaux plus longs que les basaux, lancéolés, très longuement poilus en dehors, avec 4 longues soies en dedans, dans la moitié terminale ; lamelles intermédiaires petites, subfiliformes, arquées et glabres ; lamelles inférieures ne dépassant pas le tiers basal des articles terminaux, obtus, avec des poils recourbés. Taille 3·2 mm.

Calcutta, juillet 1907 (Annandale).

3. *Tanytarsus breviventris*, sp. nov.

♀. D'un brun clair ; pattes d'un blanc brunâtre. Yeux glabres, réniformes, distants au vertex. Articles des palpes cylindriques ; le 1er deux fois aussi long que gros ; 2e et 3e égaux, quatre fois aussi longs que gros ; 4e égal aux deux précédents réunis, mais plus mince. Antennes de 5 articles ; 2e article subcylindrique, rétréci au milieu ; 3e et 4e subfusiformes, 2 à 3 fois aussi longs que gros ; 5e deux fois aussi long que le 4e, subcylindrique, un peu épaissi au-dessus de la base ; article 2e avec deux verticilles de soies, les suivants avec un verticille ; soies trois fois aussi longues que l'article. Ailes velues, bord postérieur en angle obtus à la base ; extrémité du radius située vis-à-vis de l'extrémité du rameau inférieur de la posticale ; cubitus non dépassé par la nervure costale, aboutissant assez près de la pointe alaire ; discoïdale arquée par en bas à partir de la transversale qui est oblique et presque ponctiforme, aboutissant à peine en-dessous de la pointe alaire, bifurcation de la posticale située en arrière de la transversale ; rameau supérieur de la posticale continuant la direction de la tige, à peine arqué ; l'inférieur oblique, non arqué. Poils des pattes antérieures deux fois aussi longs que l'épaisseur des pattes ; les quatre tibias postérieurs terminés par un anneau brun, dentelé et occupant les deux tiers du pourtour ; métatarse antérieur $2\frac{1}{2}$ fois aussi long que le tibia, égalant les trois articles suivants réunis ; empodium filiforme, un peu plus court que les crochets, à deux rangées de poils sur le dessous ; pulvilles nuls. Abdomen pas plus long que le reste du corps, non rétréci à la base ; lamelles lancéolées. Taille 1·8 mm.

Calcutta, juillet 1907 (Annandale).

4. *Tanytarsus pilosipennis*, sp. nov.

♀. D'un jaune brunâtre ; pattes d'un jaune blanchâtre. Ailes graduellement amincies à la base, ne formant pas d'angle ; nervure transversale non oblique, continuant la direction du cubitus et de la tige de la discoïdale ; sous-costale, radius et cubitus avec de fortes soies. Tarses antérieurs brisés. Taille 1·5 mm. Pour tout le reste, semblable au précédent.

Calcutta, juillet 1907 (Annandale).

5. *Tanytarsus* (*Micropsectra*) *indicus*, sp. nov.

♀. D'un brun clair en entier. Pulvilles atteignant la moitié de la longueur des crochets. Pour tout le reste, semblable à *C. setosipennis*. Antennes et tarses antérieurs brisés. Taille 3·2 mm.

Calcutta, juillet 1907 (N. Annandale).

3e Genre, Conocladius, gen. nov.

Yeux glabres, distants de toute leur longueur au vertex, subovoïdaux ; vertex s'élevant à partir des yeux et s'amincissant graduellement en un cône obtus et aussi long que les yeux. Palpes composés de 4 articles. Antennes de 14 articles, à poils divariqués. Ailes ponctuées, graduellement amincies à la base comme chez *Tanytarsus* ; nervation comme chez *Tanytarsus*. Tibia antérieur un peu plus long que le métatarse, tibias postérieurs seuls munis d'un peigne composé de spinules fines et libres jusqu'à leur base ; crochets tarsaux simples ; empodium et pulvilles nuls. Ce genre appartient au groupe *Orthocladius*.

Conocladius flavus, sp. nov.

(Pl. xi, fig. 15, tête ; fig. 13, moitié de la pince anale.)

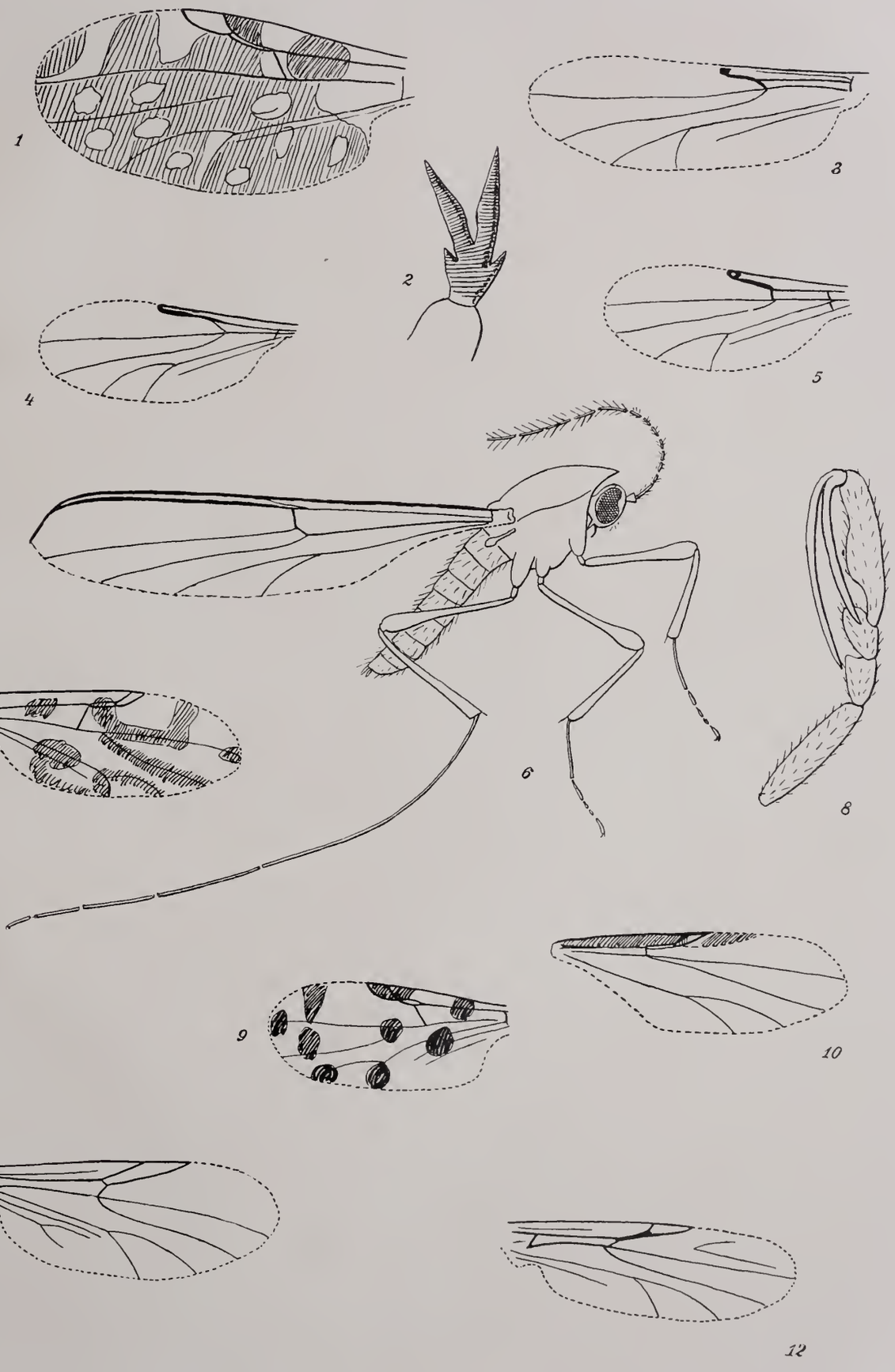
♂. D'un jaune clair ; antennes, sternum, taches sur les pleures, deux taches du scutellum, et trois bandes du mesonotum bruns. Premier article des palpes guère plus long que gros ; 2e et 3e égaux, trois fois aussi longs que gros ; 4e à peine plus long que le 3e. Article 2e des antennes un peu plus long que le 3e, qui est à peine plus long que gros ; 4-13 presque deux fois aussi longs que gros ; 14e aussi long que les articles 2-13 réunis. Ailes hyalines ; radius aboutissant vis-à-vis de l'extrémité du rameau inférieur de la posticale ; 2e nervure nulle ; cubitus deux fois aussi distant de la pointe alaire que la discoïdale, celle-ci faiblement courbée par en bas à sa base ; transversale continuant la direction du cubitus et de la base de la discoïdale, bifurcation de la posticale située en arrière de la transversale, les deux rameaux longs, à peine arqués, et faiblement divergents. Pattes sans longs poils. Pince comme dans le groupe *Orthocladius* ; article basal avec un lobe court, au milieu du bord interne ; article terminal arqué, trois fois aussi long que gros, faiblement aminci aux deux bouts, muni à son extrémité, d'un stylet filiforme et trois fois aussi long que gros. Taille 1·8 mm.

Calcutta.

EXPLICATION DE LA PLANCHE VIII.

(*Tous les dessins sont exécutés à l'aide de la camera lucida, sauf la fig.* 6.)

FIG. 1.—Aile de *Culicoides peregrinus*, sp. nov., ♀.
,, 2.—Crochets des tarses postérieurs de *Calyptopogon albitarsis*, sp. nov., ♀.
,, 3.—Aile de *Culicoides montivagus*, sp. nov., ♂.
,, 4.—Aile de *Culicoides macrostoma*, sp. nov., ♀.
,, 5.—Aile de *Culicoides paivai*, sp. nov., ♀.
,, 6.—*Calyptopogon albitarsis*, sp. nov., ♀.
,, 7.—Aile de *Culicoides odiosus*, sp. nov., ♀.
,, 8.—Derniers articles des tarses postérieurs de *Palpomyia* (*Sphæromyias*) *viridiventris*, sp. nov., ♀.
,, 9.—Aile de *Culicoides molestus*, sp. nov., ♀.
,, 10.—Aile de *Ceratopogon albonotatus*, sp. nov.
,, 11.—Aile de *Bezzia facialis*, sp. nov., ♂.
,, 12.—Aile de *Ceratopogon* (*Atrichopogon*) *indianus*, sp. nov., ♂.



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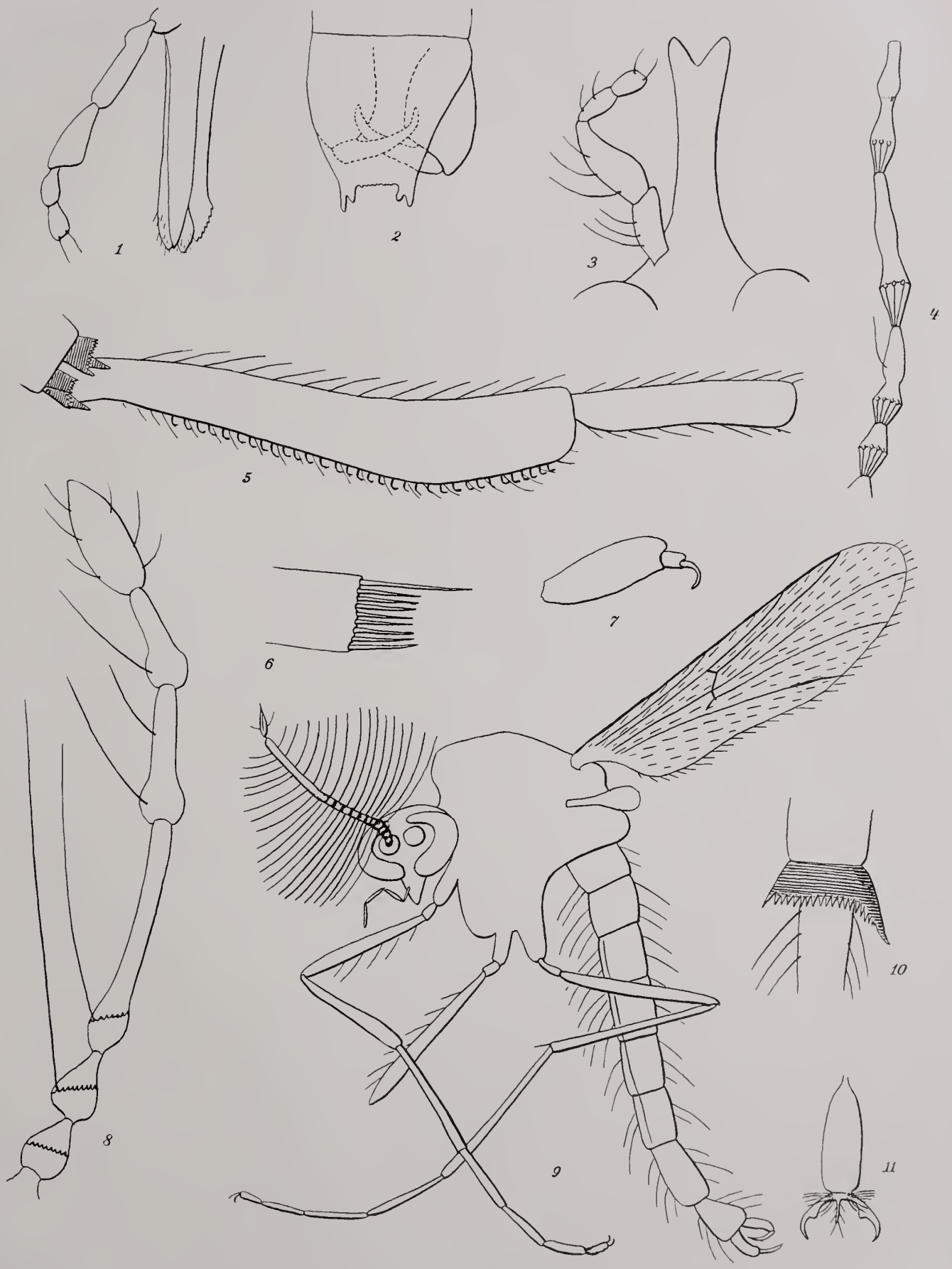
EXPLICATION DE LA PLANCHE IX.

(*Toutes les figures sont faites à la camera lucida.*)

FIG. 1.—Parties buccales de *Culicoides oxystoma*, sp. nov., ♀ .
,, 2.—Pince anale de *Culicoides quadrilobatus*, sp. nov., ♂ .
,, 3.—Parties buccales de *Ceratopogon macrorhynchus*, sp. nov., ♂ .
,, 4.—Articles antennaires 9-12 de *Culicoides quadrilobatus*, sp. nov., ♂ .
,, 5.—Deux premiers articles des tarses intermédiaires de *Tanytarsus clavatitarsis*, sp. nov., ♀ .
,, 6.—Peigne du tibia postérieur de *Isoplastus annandalei*, sp. nov., ♂ .
,, 7.—Article terminal du tarse antérieur de *Isoplastus annandalei*, sp. nov., ♂ .
,, 8.—Six derniers articles antennaires de *Ceratopogon macrorhynchus*, sp. nov., ♂ .
,, 9.—*Isoplastus annandalei*, sp. nov., ♂ .
,, 10.—Anneau dentelé du tibia postérieur de *Chironomus annandalei*, sp. nov., ♀ .
,, 11.—Dernier article du tarse antérieur de *Chironomus annandalei*, sp. nov., ♀ .



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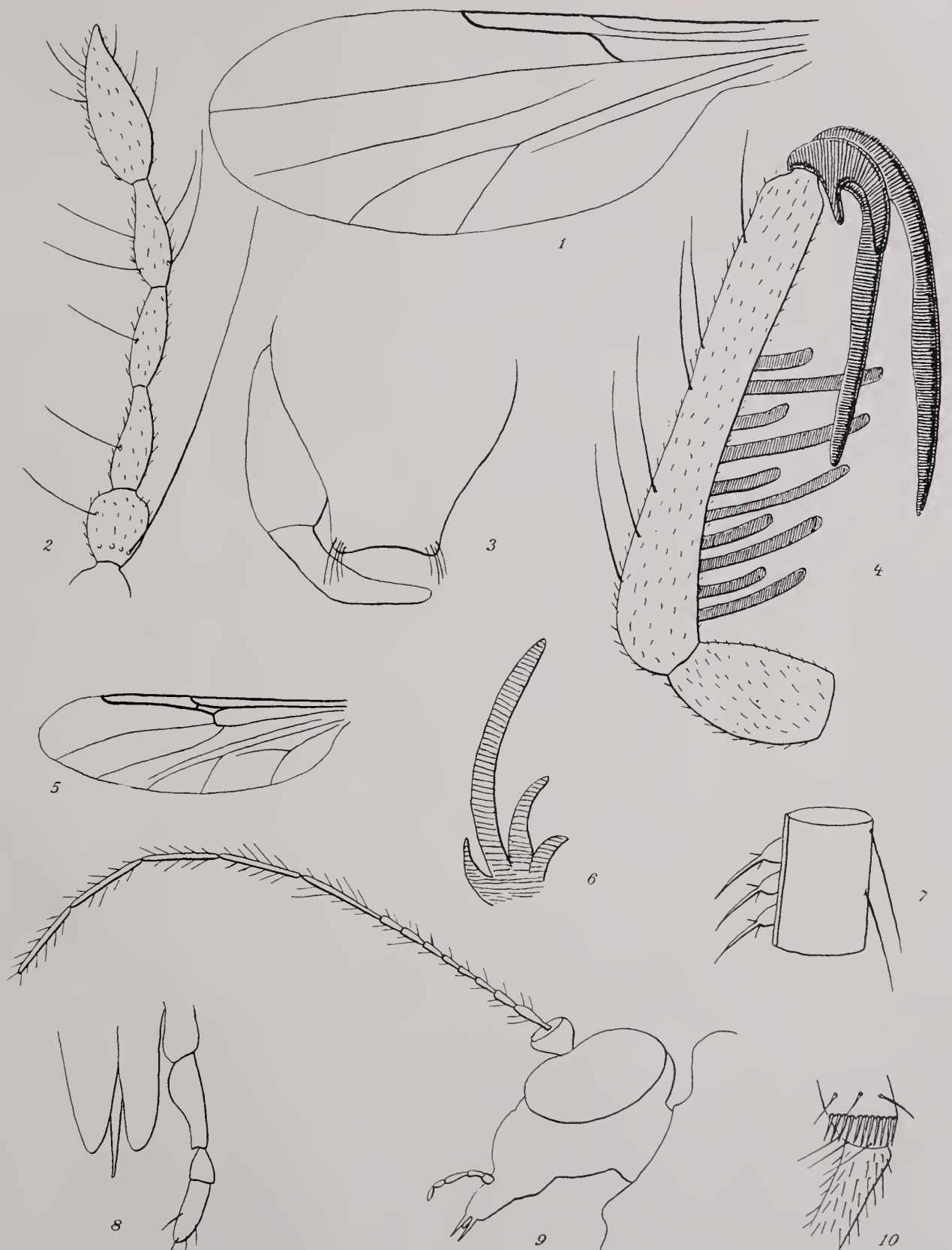
EXPLICATION DE LA PLANCHE X.

(*Toutes les figures sont faites à la camera lucida.*)

FIG. 1.—Aile de *Culicoides setiger*, sp. nov.
,, 2.—Cinq derniers articles de l'antenne du mâle du même insecte.
,, 3.—Partie de la pince de *Culicoides setiger*, sp. nov.
,, 4.—Deux derniers articles des tarses antérieurs de *Palpomyia filicornis*, sp. nov., ♀.
,, 5.—Aile du même insecte.
,, 6.—Crochets tarsaux des quatre pattes postérieures du même insecte.
,, 7.—Portion du métatarse postérieur avec les soies bulbeuses du même insecte.
,, 8.—Bouche et palpe de *Culicoides quadrilobatus*, sp. nov., ♀.
,, 9.—Tête et antenne de *Palpomyia filicornis*, sp. nov., ♀.
,, 10.—Peigne de l'extrémité du tibia de *Culicoides quadrilobatus*, sp. nov.



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EXPLICATION DE LA PLANCHE XI.

(Toutes les figures sont faites à la camera lucida.)

FIG. 1.—Deux derniers articles des tarses postérieurs de *Palpomyia* (*Sphæromyias*) *bisignata*, sp. nov., ♀ .

,, 2.—Deux derniers segments abdominaux et pince de *Chironomus camptogaster*, sp. nov., vus de côté.

,, 3.—Antenne de *Culicoides opacus*, sp. nov., ♀ .

,, 4.—Deux derniers articles antennaires de *Chironomus fasciatipennis*, sp. nov., ♀ .

,, 5.—Trois derniers articles des tarses postérieurs de *Palpomyia* (*Sphæromyias*) *bimacula*, sp. nov., ♂ .

,, 6.—Aile de *Procladius fuscosignatus*, sp. nov.

,, 7.—Aile de *Palpomyia* (*Sphæromyias*) *bimacula*, sp. nov., ♂ .

,, 8.—Aile de *Palpomyia pulchripes*, sp. nov., ♀ .

,, 9.—Crochets des tarses antérieurs de *Palpomyia* (*Sphæromyias*) *filitarsis*, sp. nov., ♀ .

,, 10.—Aile de *Ceratopogon decipiens*, sp. nov., ♂ .

,, 11.—Partie de la pince anale de *Chironomus longivalvis*, sp. nov.

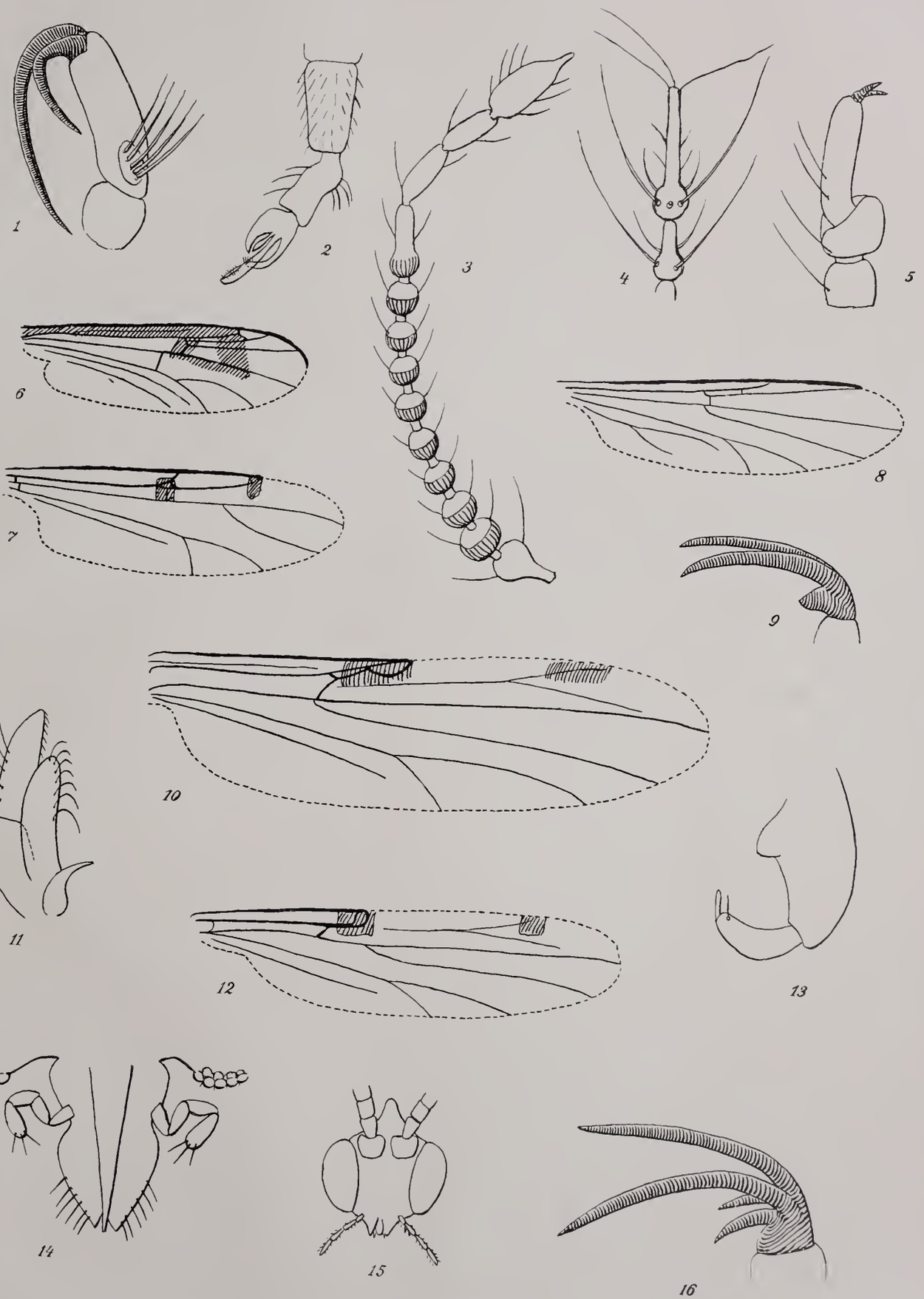
,, 12.—Aile de *Ceratopogon auronitens*, sp. nov., ♂ .

,, 13.—Pince anale de *Conocladius flavus*, sp. nov., ♂ .

,, 14.—Parties buccales et bord antérieur des yeux de *Culicoides macrostoma*, sp. nov., ♀ .

,, 15.—Tête de *Conocladius flavus*, sp. nov., vue de devant.

,, 16.—Crochets des tarses antérieurs de *Palpomyia interrupta*, sp. nov., ♀ .



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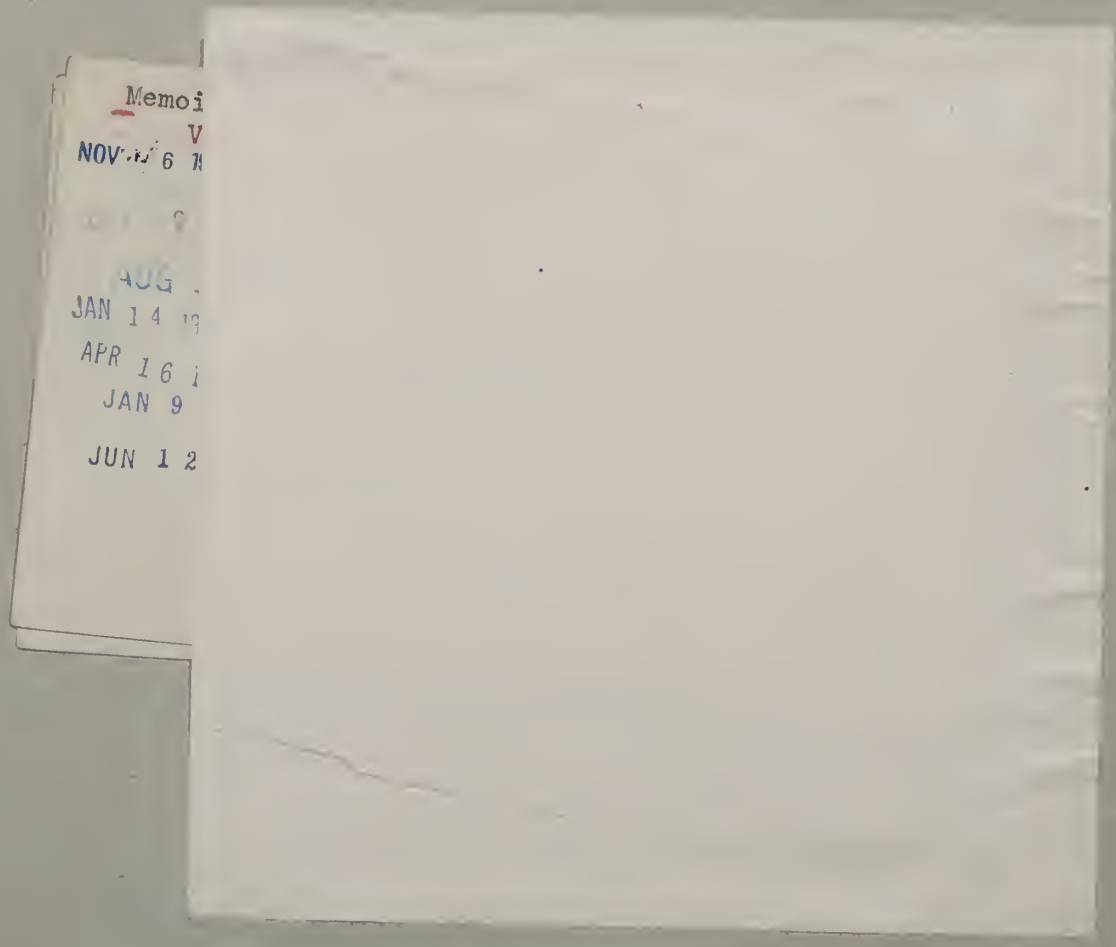
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